Psychometric Properties of the 30 Item Wisconsin Inventory of Smoking Dependence Motives (WISDM-30) among African American Light Smokers

Carrie A. Bronars, M.A

Submitted to the Department of Psychology and the
Faculty of the Graduate School of the University of Kansas
In partial fulfillment of the requirements for the degree of
Doctorate of Philosophy

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Date Defended: May 11, 2011

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ABSTRACT

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Despite smoking fewer cigarettes per day, African American smokers have greater difficulty quitting when compared to other ethnic groups. Identifying factors associated with smoking among these high-risk smokers may assist in developing effective smoking cessation interventions. This study examined the psychometric properties of the WISDM-30 (Smith et al., 2007) among a sample of 515 African American light smokers. Unlike the WISDM-30 which has a 10 factor solution, results from both an EFA and CFA analysis suggest a 27-item version of the WISDM with 8 subscales was the best solution to evaluate nicotine dependence in this sample. The 8-factor model replicated seven of the factors originally reported by Smith and colleagues (2007) for the WISDM-30 (e.g., Affiliative Attachment, Automaticity, Cognitive Enhancement, Negative Reinforcement, Social Support, Taste/Associative Processes, and Weight Loss). The final factor consisted of the original three craving items plus two items from the Tolerance/Loss of Control subscale as well as one item from the Cue Reactivity subscale. In addition, all 8 subscales were found to load on a single higher order factor, indicating each of these areas measures a unified construct. Internal reliability was improved by combining these items, further providing support to the results obtained in the EFA and CFA analyses showing a combined subscale. The Automaticity and Craving subscales of the WISDM-27 were associated with smoking level, while subscale scores did not differ by gender. Results from this study provide an initial validation of the WISDM-30 among African American light-smokers and highlight specific factors related to nicotine dependence in this population.

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Table of Contents

List of Tables

List of Figures

Table of Abbreviations

CDS	Cigarette Dependence Scale
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CPD	Cigarettes per day
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
EFA	Exploratory Factor Analysis
FTND	Fagerström Test of Nicotine Dependence
MNWS	Minnesota Nicotine Withdrawal Scale
NDSS	The Nicotine Dependence Syndrome Scale
QSU-Brief	Questionnaire for Smoking Urges, Brief Version
RMSEA	Root Mean Square Error of Approximation
SEM	Structure Equation Modeling
SRMR	Standardized Root Mean Square Residual
TFI/NNFI	Tucker-Lewis Index or the Non-normed Fit Index
TTFC	Time to first cigarette
WISDM	Wisconsin Inventory of Smoking Dependence Motives

Chapter 1

INTRODUCTION

Cigarette smoking remains the leading cause of morbidity and mortality in the United States, accounting for approximately one out of every five deaths each year or 438,000 deaths annually (CDC, 2007). About 43.4 million people (19.8% of adults) in the United States are current smokers (CDC, 2007). While cigarette smoking has decreased approximately six percent within the last decade (CDC, 2006), the proportion of "light smokers," or those who maintain a low level of daily cigarette consumption is rising (Fagen & Rigotti, 2009; Okuyemi, Harris, et al., 2002; Pierce, Messer, White, Cowling, & Thomas, 2011; Porter, Jackson, Trosclair, & Pederson, 2003). While there is no single standard definition, light smoking commonly refers to daily smokers who consume 10 or fewer cigarettes per day (Okuyemi, Cox, et al. 2007). Light smoking appears particularly common among certain sub-populations in the United States, such as teens, young adults, women and African Americans (Ahluwalia, Harris, Catley, Okuyemi, & Mayo, 2002; Kandel & Chen, 2000; Okuyemi, Harris, et al., 2002).

Nicotine, the primary psychoactive agent in tobacco, induces dependence in the majority of smokers, and is thought to be largely responsible for continued and repeated tobacco use (USDHHS, 1988; Benowitz, 1996). Despite the known heath risks associated with smoking, the majority of cigarette smokers are unable to maintain abstinence after a cessation attempt, with approximately 70 to 90% of individuals returning to smoking within the first year of quitting (Fiore, et al, 2000; Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992). While the role of nicotine in fostering dependence on tobacco has been established, several models of nicotine dependence exist within the literature, and they

differ with respect to the processes or mechanisms that sustain cigarette use (Tiffany, Conklin, Shiffman, & Clayton, 2004). This lack of consensus within the field regarding a generally accepted theory of nicotine dependence impedes the development of novel assessment tools and treatments for nicotine dependence (Piper, McCarthy, & Baker, 2006). Further understanding of how nicotine contributes to an individual's development and maintenance of smoking behavior may provide more efficacious treatments that promote cessation and reduce the risk of premature death related to illnesses such as cancer, heart disease, and stroke (Fagerström, 2002; Taylor, Hasselblad, Henley, Thun, & Sloan, 2002; USDHHS, 1990).

Although light smoking may be perceived by smokers as a reduced or minimal health risk, studies have shown that light smokers do suffer from smoking related illnesses when compared to never smokers (Gandini, et al., 2008; Garfinkel & Stellman, 1988; Jimenez-Ruiz, Kunze, & Fagerström, 1998). For instance, light smoking increases the risk of cardiovascular-related deaths by 60% compared to nonsmokers (Luoto, Uutela, & Puska, 2000), and the risk of coronary heart disease among light smokers approaches that of heavier smokers (Rosengren, Wilhelmsen, & Wedel, 1992).

Approximately 50% of African American smokers are light smokers (Caraballo, et al., 1998; Okuyemi, Ahluwalia, et al., 2004; Okuyemi, Ahluwalia, Richter, Mayo, & Resnicow, 2001); however, they experience a disproportionate share of tobacco-related morbidity and mortality (Harris, Zang, Anderson, & Wynder, 1993). Further, despite this low rate of daily cigarette consumption, African American smokers have higher serum cotinine levels per cigarette smoked (Benowitz, 1996; Benowitz, Bernert, Caraballo, Holiday, & Wang, 2009; Caraballo et al., 1998), are more susceptible to developing

smoking-related illnesses (American Cancer Society, 2008; Haiman, et al., 2006), and have greater difficulty quitting smoking when compared to Caucasian smokers (UDHHS, 1998; Royce, Hymowitz, Corbett, Hartwell, & Orlandi, 1993). Because the protocols of most smoking cessation trials exclude light smokers, there is little published data on the factors associated with smoking in this subset of smokers (Ahluwalia et al., 2006; Fiore et al., 2008). Identifying factors related to cigarette use among African Americans, even those who might be considered light smokers, may be helpful in reducing smoking-related illnesses in this group.

Despite increased attempts to stop smoking, African Americans demonstrate lower rates of quitting, suggesting potentially higher levels of nicotine dependence. Few studies have examined nicotine dependence among African American light smokers. The Wisconsin Inventory of Smoking Motives, 30 item measure (WISDM 30), consists of a multidimensional measure of nicotine dependence. Although used to evaluated smoking-related motivation in a number of studies (Piper et al., 2004; Piper et al., 2008; Shenassa, Graham, Burdzovic, & Buka, 2009; Smith, Piper, Fiore, & Baker, 2007), the questionnaire has not been previously employed with a sample of African American light smokers. The proposed study will examine the psychometric properties of the WISDM-30 in this population.

Chapter 2

REVIEW OF THE LITERATURE

Tobacco Use and Health

Worldwide, tobacco use is responsible for more than 5 million deaths per year, and current trends show tobacco use will cause more than 8 million deaths annually by 2030 (WHO, 2008). In the United States, smoking is the leading cause of preventable death (CDC, 2002), and is responsible for approximately one in five deaths annually (CDC, 2008). In addition, for every individual who dies of a smoking-related disease, 20 more people suffer from at least one serious illness resulting from smoking (CDC, 2003). On average, smokers die 13 to 14 years earlier than nonsmokers (CDC, 2002), and smoking increases the length of time people live with a disability by about two years (Nusselder, Looman, Marang-van de Mheen, van de Mheen, & Mackenbachet, 2000).

Each year, roughly 193 billion dollars are spent on health related costs due to lost productivity and health care expenses (CDC, 2008). In the United States, cigarette smoking is responsible for at least 30% of all cancer deaths and 87% of all lung cancer deaths (Fagerström, 2002; USDHHS, 1989). Cigarettes contain 43 known carcinogenic compounds, which have been linked to cancers of the lung, esophagus, bladder, kidney, stomach, uterine cervix, and pancreas (Fagerström, 2002; Cincirpini, Hecht, Henningfield, Manley, & Kramer 1997, USDHHS, 2004). The risk of developing lung cancer is about 23 times higher in male smokers and 13 times higher in female smokers compared to lifelong nonsmokers (USDHHS, 1989). Further, smoking doubles an individual's risk of developing coronary heart disease, stroke, and peripheral vascular disease in comparison to nonsmokers (USDHHS, 1989, 2004). In addition, irritation and damage of the respiratory tract as a result of smoking heightens the risk of developing chronic obstructive

pulmonary disease (COPD), pneumonia, and influenza (Cincirpini et al., 1997; Sherman, 1992). About 90% of all deaths from chronic obstructive lung diseases are attributable to cigarette smoking (USDHHS, 2004).

Nicotine Dependence

Nicotine, the primary psychoactive agent in tobacco, produces dependence in the majority of smokers, and is thought to be largely responsible for continued and repeated tobacco use (USDHHS, 1988; Benowitz, 1996). After inhalation, nicotine reaches the brain in approximately 10 to 19 seconds via arterial circulation (Chassin, Presson, Sherman, & Edwards, 1990). Nicotine acts on receptors in the central nervous system and leads to the release of neurotransmitters such as acetylcholine, dopamine, serotonin, and norepinephrine (Benowitz, 1996; Zbikowski, Swan, & McClure, 2004). The reinforcing effects of nicotine are thought to arise from the activation of the mesocorticolimic dopamine system, specifically the ventral tegmental area and the nucleus accumbens (Benowitz, 2008). The release of dopamine has been linked to feelings of pleasure and relief from anxiety, improved memory, mood modulation, and skeletal muscular relaxation (Benowitz, 1996; Benowitz, 2008). When nicotine levels decrease in the body, symptoms of nicotine withdrawal emerge within the first 24 hours, peak within the first week of abstinence, and persist for approximately one month (Hughes & Hatsukami, 1986; Hughes, 2007). Symptoms of withdrawal include: irritability, difficulty concentrating, dry mouth, depressed mood, insomnia, craving, hunger, anxiety, restlessness, dizziness, and constipation (Hughes, 2007). These effects of nicotine withdrawal help explain the maintenance of tobacco addiction and the difficulty most tobacco users experience when quitting (Zbikowski et al., 2004; Benowitz, 2008).

Researchers postulate the development and maintenance of nicotine dependence results from a complex interaction between biological variables, environmental influences, and psychological factors (Altman et al., 1996; Buchhalter, Fant, & Henningfield, 2008; Hatsukami, Stead, & Gupta, 2008). Treatments of nicotine dependence usually address each of these components through the use of both pharmacotherapy (e.g., nicotine replacement products) and counseling (e.g., behavior therapy) to ameliorate withdrawal symptoms and reduce the likelihood of relapse (Burke, Ebbert, & Hayes, 2004; Fiore et al., 2008). In treatment settings, identification of nicotine dependent smokers is based on a set of characteristics delineated in the Diagnostic and Statistical Manual of Mental Disorders (text revision, 4th ed; DSM-IV). According to the DSM-IV, a diagnosis of nicotine dependence is made if an individual meets three of seven criteria during a 12-month period. These criteria include symptoms of tolerance (i.e., the decrease in the effects of the drug over time with repeated use) and withdrawal. The remaining five DSM-IV criteria are the following: the substance is taken over longer periods of time than intended; the individual desires to but is unable to limit their use; use continues despite its being harmful to the individual; a great deal of time is spent in activities necessary to acquire or use the substance; and continued use creates problems in social and occupational functioning (American Psychiatric Association, 2000).

A majority of cigarette smokers are unable to maintain abstinence after a cessation attempt, with approximately 70 to 90% of individuals returning to smoking within the first year of quitting (Fiore et al, 2000; Garvey, Bliss, Hitchcock, Heinold & Rosner, 1992; Krall, Garvey, & Garcia, 2002). No available smoking cessation therapy to date has produced long term abstinence rates greater than 50% (Fiore et al., 2000). Researchers suggest the threat of relapse exists not only for smokers attempting to quit, but also among former smokers abstinent for a

prolonged period of time (Krall et al., 2002; Ockene et al., 2000). However, many smokers (62%) relapse within the first two weeks of quitting (Garvey et al., 1992; Hughes, Peters, & Naud, 2008; Piasecki, 2006). Individuals displaying a greater number of nicotine dependence symptoms have a greater likelihood of relapsing during a cessation attempt than individuals considered to be less nicotine dependent (Agrawal, Sartor, Pergadia, Huizink, & Lynskey, 2008; Cosci et al., 2009; Shiffman et al., 1996; Siahpush, McNeill, Borland, & Fong, 2006). While the relationships between nicotine and nicotine dependence in the maintenance of smoking behavior in adults is clear (USDHHS, 1988), the underlying mechanisms supporting this relationship are uncertain.

Current models of nicotine dependence focus on the roles played by different factors in sustaining tobacco use (Shadel, Shiffman, Niaura, Nichter, & Abrams, 2000). For instance, medical models emphasize the physiological role of nicotine, the addictive component in tobacco products, as a primary factor contributing to nicotine dependence. Negative reinforcement models of nicotine dependence emphasize the role played by the repeated consumption of tobacco products in allowing tobacco users to avoid or escape aversive experiences such as negative affect and withdrawal symptoms themselves (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; Eissenberg, 2004). Further, negative reinforcement models suggest that some aversive experiences are enhanced as a consequence of repeated exposure to nicotine, thereby resulting in a vicious cycle that motivates continued tobacco use (Tiffany et al., 2004).

Positive reinforcement models suggest that the immediate pleasurable effects of nicotine function as reinforcers that promote continued use over time (Glautier, 2004). Once a smoker inhales the smoke from a cigarette, nicotine reaches the brain within 7 to 10 seconds and stimulates the release of dopamine (Benowitz, 2008). Pleasurable effects of nicotine such as

arousal, improved concentration, and reduced hunger are instantly perceived by the smoker (Benowitz, 2008). Positive reinforcement models also explain how the delayed health consequences of smoking decline in reinforcement value in comparison to the immediate, pleasurable effects to nicotine for the nicotine-dependent smoker (Glautier, 2004). Further, the opportunity to engage in smoking behavior takes priority over other pleasurable activities among more dependent smokers (Tiffany et al., 2004).

Cognitive and social learning models emphasize the importance of concepts such as expectancies and self-efficacy (Brandon, Herzog, Irvin, & Gwatlney, 2004) in the development and maintenance of nicotine dependence. For instance, Goldman's (1999) expectancy model proposes that one's beliefs about the benefits or consequences of a smoking will influence current and future smoking behavior. The strength of the expectancy, regardless of its accuracy, is thought to impact nicotine dependence by maintaining certain beliefs about the benefits of smoking (Juliano & Brandon, 2002). The perceived benefits of smoking, such as: smoking will reduces stress, boredom, cigarette craving, and negative affect; smoking will increase social interaction, energy levels; and the taste of cigarette smoke decreases a smokers desire to quit. In turn, the negative consequences of smoking are thought to reduce the desire of a person to smoke and prompt quitting (Copeland, Brandon, & Quinn, 1995).

Bandura's (1999) construct of self-efficacy refers to the perception of a person regarding his or her ability to execute a specified behavior in addition to the motivation one has to do so. With regard to nicotine dependence, self-efficacy is most often referred to one's ability to refrain from smoking. Previous unsuccessful quit attempts are thought to create a diminished sense of self-efficacy among smokers. This reduction in abstinence self-efficacy contributes to smokers' perception of having lost control over their smoking behavior, and difficultly refraining from

smoking despite health consequences (Colby, Tiffany, Shiffman, & Niaura, 2000). In a meta-analysis of 21 studies examining predictors of smoking abstinence at 6 months, low self efficacy ratings were found to predict relapse among both self-quitters and treated smokers (Ockene et al., 2000).

Despite their diversity, all models of nicotine dependence assume that repetitive drug use is a learned behavior, nicotine dependence varies on a continuum, and that dependence is a multidimensional construct (Tiffany, et al., 2004). Each model emphasizes specific processes that are instrumental in either creating or sustaining dependence. Not surprisingly there is no clear consensus on a single model of nicotine dependence. The complexity in elucidating the role of nicotine dependence in creating and sustaining smoking behavior is likely based on several interacting, complex factors. The assessment of nicotine dependence provides an opportunity not only to strengthen current models related to nicotine dependence, but also to serve as means of generating newer, more comprehensive models.

Definitions of Light Smoking

Recent population estimates suggest about 29% of smokers in the U.S. consume 9 or fewer cigarettes per day (Pierce et al., 2011). Unlike alcohol use, in which certain levels of drinking are considered safe, no safe level of smoking has been established. Duration of smoking, as opposed to frequency, provides a better indicator of the development of smoking-related ailments, including cancer, pulmonary illness, and heart disease (Shane, Ling, Glantz, 2010; Rosengren et al., 1992). Light smoking increases the risk of cardiovascular-related deaths by 60% compared to nonsmokers (Luoto et al., 2000), and the risk of coronary heart disease among light smokers parallels that of heavier smokers (Rosengren et al., 1992; Schane et al., 2010) In addition, the risk of developing chronic obstructive pulmonary disease (COPD) rises to

4.2 for smokers using fewer than 10 cigarettes per day in comparison to nonsmokers (USDHHS, 1990).

Despite the health risks associated with lower levels of smoking, a lack of a general, consistent definition exists concerning what constitutes light smoking. Researchers have employed various terms such as light (Falba, Jofre-Bonet, Busch, Suchovny, & Sindelar 2004; Okuyemi, Harris, et al., 2002; Shiffman, 2005); intermittent (Lindstrom & Ostergren, 2001), chipper (Etter, 2004; Henningfield, 1992; Shiffman, 1991), low rate (Owen, Kent, Wakefield, & Roberts, 1995; Zhu, Sun, Hawkins, Pierce, & Cummings, 2003), occasional (Barengo, Sandstrom, Jormanainen, & Myllykangas 2004; Luoto el al 2000), non-daily (Hutsen, McCarty, Giovino, Chrismon, & Zhu, 1998; Wortley, Hutsen, Trosclair, Chrismon, & Pederson, 2003), or cigarette sampler (Kenford et al., 2005) to describe low rate smoking. Differences in these labels pertain to the frequency and amount of cigarettes consumed. For instance, chippers are defined as smoking 5 or less cigarettes per day, at least four days during the week (Shiffman, 1989), while intermittent smokers are defined as individuals who have consumed 100 cigarettes or more in their lifetime but have never smoked daily (Husten et al., 1998). Although the number of cigarettes per day (CPD) is used to characterize light smokers, the range has varied widely among studies. Often terms have been interchanged and used to describe different smoking patterns. For example, Okuyemi and colleagues define light smoking as less than 10 cigarettes per day (Okuyemi, Harris, et al, 2002; Okuyemi, Ahluwalia, et al., 2004) while Shiffman (2005) and Falba (2004) set the criteria for light smoking at less than 15 cigarettes per day. Due to the lack of a uniform definition in the literature, the actual proportion of light smokers in the current population is not well established (Trinidad et al., 2009). Until recently, a majority of clinical trials only included participants smoking at least 15 CPD, ignoring the population of light

smokers. Given the paucity of research including light smoking populations in smoking cessation research, Okuyemi and colleagues (2002) proposed defining light smoking as the use of 10 or fewer cigarettes per day.

African Americans

Approximately 39.6 million African Americans live in the United States (U.S. Census Bureau, 2011). An estimated 5.8 million African American adults smoke cigarettes, accounting for nearly 13% of all adults who are current smokers in the United States (CDC, 2006). Groups with highest prevalence of smoking include African American men, and African Americans of either gender who have lower levels of education and socio-economic status (Ahluwalia, McNagny, & Clark, 1993; CDC, 2002). Smokers from ethnic minority populations are more likely to consume cigarettes at lower rates, with approximately 44 to 50% of African American smokers consuming 10 or fewer cigarettes per day (Okuyemi, Harris, et al., 2002; USDHHS, 1998; Webb & Carey, 2008) Despite smoking fewer cigarettes, African American are more susceptible to developing smoking-related illnesses (e.g., lung cancer) and are less likely to succeed in quitting than Caucasians (Robles, Singh-Franco, & Ghin, 2008; USDHHS, 1998). Differences between African Americans and Caucasians in adult tobacco use and consequent mortality (CDC, 1994) are attributable, in part, to socioeconomic (Royce et al. 1993; Scarinci, Robinson, Alfano, Zibkowski, & Klesges, 2002;Siahpush, Singh, Jones, & Timsina, 2010) and psychological factors (Romano, Bloom, & Syme, 1991; Webb & Carey, 2008) rather than to race per se. However, compared to whites, African Americans exhibit significant differences with regard to some aspects of tobacco use (Okuyemi et al., 2004). African Americans begin smoking later (Moolchan et al., 2007; Romano et al., 1991) smoke more mentholated cigarettes and brands with higher levels of tar and nicotine (Gundersen, Delnevo, & Wackowski, 2009;

Okuyemi, Cox, et al., 2007; Okuyemi, Faseru et al., 2007), inhale more deeply with the capacity to achieve higher indexes of smoke inhalation (Ahijevych, Weed, Clarke, 2004; Romano et al., 1991;), and are more likely to smoke within 30 minutes of awakening -- a behavioral indicator of nicotine dependence (Ahluwalia et al., 1998; Baker et al., 2007; Royce et al. 1993).

Although African American smokers are more likely to attempt to stop smoking within a given year than Caucasian smokers, these attempts result in 18 to 34% reduced abstinence success at six months (King, Sanchez-Johnson, Van Orman, Cao, & Matthews, 2008; CDC, 1994; Robles et al., 2008) Higher number of quit attempts suggests an interest in stopping smoking and also perhaps a gap in access to or effectiveness of cessation resources for African American smokers (Royce et al., 1993). African Americans are less likely to receive smoking cessation intervention or advice to stop smoking (USDHHS, 1998; Cokkinides, Halpren, Barbeau, Ward, & Thun, 2008) and are less likely to seek treatment for smoking cessation (Zhu et al., 2003). Facilitating smoking cessation among African Americans, particularly those with fewer socioeconomic resources, is a national health concern.

Quitting Patterns of African American Light Smokers

Little research exists on quitting patterns of light smokers, and this omission impedes the development of cessation strategies targeting this population. Okuyemi and colleagues (2004) surveyed 484 African American smokers including 176 light smokers (1-10 CPD) to assess smoking characteristics and cessation experiences. In their sample, light smokers tended to be younger and female, and more likely to have initiated smoking at an older age. Light smokers showed more motivation and confidence to quit compared to moderate (11-20 CPD) and heavier smokers (>20 CPD). Across all smoking categories, participants attempted to quit smoking on average once in the past year and twice over their lifetime. Despite their high motivation and

multiple quit attempts, light smokers reported experiencing difficulty quitting (Robles et al., 2008). Choi (2004) examined the smoking relapse curves in a sample of 474 African American smokers, 224 light smokers (1-10 CPD) and 250 moderate to heavy smokers (11 or more CPD). Results indicated light smokers had similar abstinence rates as heavier smokers and that the median length of their most recent quit attempts was also similar. Although both studies relied on participant self-reports, these results suggests light smokers may need smoking cessation interventions as much as heavier smokers do.

Smoking Cessation Interventions for African Americans

Both community and clinic-based studies examining smoking cessation interventions designed for African American participants have shown promising, though mixed results (Okuyemi, Cox, Choi, & Ahluwali 2004; Webb & Carey, 2008). Further, although many studies have evaluated pharmacotherapy for smoking cessation among white smokers, far fewer studies have assessed the efficacy of these types of interventions with African American smokers (Cox, Okuyemi, Choi, & Ahluwalia, in press; Okuyemi, Cox et al., 2004; Webb 2008). The few randomized control trials for smoking cessation interventions targeting African American smokers suggest that the use of telephone counseling (Lipkus, Lyna, & Rimer, 1999; Orleans, 1998), group cognitive behavior therapy (Murray 2001; Webb, Rodriguez de Ybarra, Baker, Reis, & Carry, 2010). Ahluwalia and colleagues (1993) found the nicotine patch be effective with African American smokers (Ahluwalia et al., 1993); however, a recent study comparing the nicotine patch with a nicotine nasal spray indicated the patch may be less effective for African American smokers (Lerman et al., 2004). While the nasal spray appeared to be more effective for African American and non-white smokers, side effects from the spray were common, and usage and nicotine replacement levels tended to be low (Lerman et al., 2004).

Ahluwalia and colleagues (2002) conducted a double-blind, placebo controlled, randomized study examining the effectiveness of bupropion and motivational interviewing in a sample of 600 AA moderate to heavy smokers (≥10cpd at screening). Participants were randomized to bupropion SR (150mg bid) or placebo for 7 weeks, and all participants received brief motivational counseling throughout the study. Abstinence rates at the end of 7 weeks of treatment were 36.0% in the bupropion SR group and 19% in the placebo group ($p<0.001$). At 26 weeks the quit rates were 21.0% for bupropion and 13.7% for placebo ($p=0.02$). Results indicated the efficacy of bupropion for smoking cessation among African American smokers.

A subsequent study by Ahluwalia (2006), employed a randomized, double-blind, placebo controlled study to determine the effectiveness of the 2 mg nicotine gum and counseling (motivational interviewing and health education) in a sample of 755 African American light smokers (≤ 10 CPD). A total of 16.7% of participants who received health education were abstinent at 26 weeks compared to 8.5% for those who received motivational interviewing. In addition, the 26 week abstinence rates for placebo and active gum were 11.1% and 14.2%, respectively. No significant interaction effect was found between type of counseling and NRT. However, a main effect was found for counseling: participants randomized to health education were more likely to have quit (cotinine verified) at week 26 (OR=2.17, CI=1.38-3.41, $p<0.0001$) compared to those randomized to motivational interviewing. These findings indicate that advice-oriented health education counseling was more effective than motivational interviewing for smoking cessation among African American light smokers who were motivated to quit, and that the 2mg nicotine gum was not more effective than placebo gum in this population.

The few randomized control trials consisting of African American smokers suggest that nicotine replacement therapy as well as counseling may increase abstinence among African Americans

trying to quit smoking. Given the limited number of studies demonstrating the efficacy of cessation interventions among African Americans as well as light smokers, it is no surprise that the current edition of the *Clinical Practice Guidelines for Treating Tobacco Use and Dependence* (2008) provides recommendations of moderate strength for medications and treatments in these populations. In addition, these guidelines specifically suggest the need for future studies to address and bolster the use of tobacco cessation interventions among African Americans and light smokers (Fiore et al., 2008).

Measuring Nicotine Dependence

Little is known about the etiology of nicotine dependence and the underlying processes of dependence that sustain tobacco use (Baker et al., 2004; Shadel et al., 2000; Tiffany et al., 2004). Therefore, developing accurate and reliable assessment tools to identify nicotine dependence among users of tobacco products is complicated. Traditional measures of nicotine dependence, such as the DSM-IV(APA, 2000) and the Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozolowski, Frecker, & Fagerström, 1991), have been utilized in the tobacco field despite criticisms regarding their ability to accurately assess nicotine dependence (Courvoisier & Etter, 2008; Hendricks, Prochaska, Humfleet, & Hall, 2008), predict smoking cessation outcome (Baker et al., 2007), and identify mechanisms associated with chronic cigarette use (Piper et al., 2006).

The DSM-IV (APA, 2000) provides a description of symptoms associated with nicotine dependence. A diagnosis of nicotine dependence is made based on established set of criteria where a smoker may fall into one of two categories: nicotine dependent or not nicotine dependent (APA, 2000). Despite its popularity in clinical settings, researchers have argued against the utility of the DSM-IV in empirical studies (Hendricks et al., 2008; Hughes, Helzer,

&Lindberg, 2006; Moolchan, Radizus, Epstein, Uhl, Gorelick, Cadet, et al., 2002; Piper, et al, 2006). The dichotomous classification of the DSM-IV provides little explanation as to how one becomes dependent and how dependence symptoms may change over time (Piper et al., 2006). Further, many of the criteria used in conjunction with the diagnosis of nicotine dependence originated from observations relating to alcohol dependence, and these behaviors or symptoms may not apply to nicotine dependence. For example, the criteria concerning the expenditure of a large amount of time obtaining or recovering from the substance is endorsed infrequently by tobacco users most likely because of the accessibility of tobacco products and the lack of intoxication effects from nicotine (Hughes et al., 2006). Researchers have demonstrated a diagnosis of nicotine dependence based on DSM-IV criteria serves as a poor predictor of relapse to smoking (Hendricks et al., 2008; Moolchan et al., 2002), and may not be a sensitive measure in identifying nicotine dependence in populations of smokers. Approximately 50% of current smokers meet DSM-IV criteria for nicotine dependence (Hughes et al., 2006), which directly contradicts the belief that almost all daily smokers are dependent (Fiore et al., 2008). Rather than providing an assessment of nicotine dependence, the DSM-IV appears to better serve as a description of nicotine dependence symptoms.

The most commonly utilized measure of nicotine dependence in the literature is the Fagerström Test of Nicotine Dependence (FTND; Heatherton et al., 1991). This instrument adopts the perspective that symptoms of dependence arise from processes related to tolerance and withdrawal, and that these physical dependence characteristics motivate continued drug use (Fagerström & Schneider, 1989). The FTND classifies dependence as a continuous variable in which people vary in their degree of dependence. Additionally, the extent of dependence is based upon the amount of physical dependence-tolerance symptoms present (Heatherton et al., 1991).

Brevity and simple administration add to the popularity of the FTND as a measure of nicotine dependence in both research and clinical practice.

Items from the FTND are listed in Appendix A. FTND scores range from 0-10 points, with a score of 0 indicating a person is experiencing a very minimal amount of nicotine dependence symptoms and a score of 10 indicating an individual is endorsing several symptoms of dependence. Generally, a cut off score of 6 or greater is indicative of severe nicotine dependence. Scores are obtained by summing the response values (Heatherton et al., 1991).

Despite its popularity, several criticisms have been levied against the FTND in the tobacco literature. First, the FTND assumes that physical dependence alone adequately captures meaningful differences in dependence severity; therefore, the measure may overlook additional processes such as craving and reinforcement that addiction researchers hypothesize to have influential effects on ND (Piper et al., 2006; Tiffany et al., 2004). Further, uncertainty regarding factor structure of the FTND places doubt as to what processes of dependence are actually being measured (Courvoisier et al., 2008; Etter, 2008; Payne, Smith, McCracken, McSherry, & Antony, 1994). The FTND was originally designed to measure nicotine dependence as a one-dimensional construct related to physical dependence; thus all items on the FTND should load as one factor. However, studies have shown two factors emerge: the first factor consisting of items related to the importance of morning smoking and cigarette preference; and the second factor pertaining to the items smoking when ill, difficulty refraining from smoking, and amount smoked. In addition, one item (i.e., time to first cigarette) dually loaded on both factors (Radzius, Gallo, Epstein, Gorelick, Cadet, Uhl, Moolchan, 2003).

The FTND contains a question which directly assesses number of cigarettes smoked. Biological markers of smoking level (e.g., carbon monoxide breath samples, cotinine, etc.) relate

directly to the number of cigarettes an individual consumes. Studies correlating these two measures generate false assumptions regarding the concurrent validity of this measure because both items should be highly related (Piper et al., 2006). In addition, the FTND provides little information regarding the etiology and course of ND among samples of smokers, thus prompting the need to develop and utilize alternative measures of dependence. Finally, men and women are thought to differ in symptoms of nicotine dependence. Men generally report symptoms related to physical dependence while women endorse more psychological reasons for smoking, such as mood, weight concerns, and stress (Wetter, Kenford, Smith, Fiore, Jorneby, & Baker, 1999; Perkins, Donny & Caggiula, 1999; Perkins et al., 2001). Men typically have higher scores on the FTND than women in both treatment and non-treatment settings (Fagerström et al., 1996). This suggests the FTND may fail to recognize nicotine dependence in women due to its focus on physical symptoms.

Newer measures of nicotine dependence have attempted to improve upon the shortcomings of the traditional measures of nicotine dependence. For instance, the Cigarette Dependence Scale (CDS; Etter, LeHouezec, & Perneger, 2003) is a self-report measure designed to assess nicotine dependence based on criteria listed in the DSM-IV (APA, 2000) and the International Classification of Diseases and Health Related Problems, 10^{th} revision (ICD-10; World Health Organization, 2007). However unlike the DSM-IV and the ICD-10, symptoms of tolerance are not included in the CDS due to the poor performance of tolerance items during the initial scale construction (Etter et al., 2003). The CDS may be administered in either a 5 or 12 item format.

Scores on the CDS-5 range from 5 to 25 and the CDS-12 range from 12-60, with higher scores suggesting a greater degree of dependence. Both versions of the CDS demonstrated high

levels of internal consistency; Cronbach's alpha coefficients are .91 for the CDS-12 and .77 for the CDS-5 (Etter 2005). Factor analysis results show the CDS-12 to consist of a single dimension (Etter et al, 2003). Scores on the CDS-5 and CDS-12 were not found to be predictive of smoking abstinence when assessed at a 45 day follow up. In comparison to the FTND, the CDS scales were more predictive of withdrawal and craving scores (Etter 2003). The CDS-5 and FTND more strongly correlated with cotinine than the CDS-12 (Etter 2003). Initial research regarding the CDS scales suggests this instrument displays adequate reliability and validity; however, more research using this measure is clearly warranted. Criticisms of the CDS scales center on its similarity to the FTND in the measurement of consequences of dependence rather than the underlying mechanisms of dependence (Piper et al., 2006).

The Nicotine Dependence Syndrome Scale (NDSS; Shiffman, Waters, & Hickcox, 2004; Shiffman & Sayette, 2005) is a 19-item self-report measure consisting of five theoretically developed subscales. Each item is rated on a five point scale (1=not true of me at all to 5=extremely true). The NDSS consists of five factor-analytically derived subscales of dependence, which are as follows:

Drive: Measures craving, withdrawal-avoidance, and desire to smoke

Priority: Assess the priority to smoke over other reinforcers

Tolerance: Refers to one's need to smoke more to get a desired effect and/or a lowered sensitivity to nicotine

Stereotypy: Rigidity in smoking patterns

Continuity: Reflects habitual smoking

Shiffman based these subscales on the Edwards and Gross theory of alcohol dependence (1976), which states the following six symptoms exist to some degree in alcohol dependent individuals:

presence of tolerance and withdrawal; drinking to avoid symptoms of withdrawal; awareness of the impulse to drink; feelings of being out of control when drinking; engaging in drink-seeking behavior over other activities; and drinking becomes habitual. In addition, these symptoms exist as manifestations underlying alcohol dependence, rather than a definition of alcohol dependence itself.

Scoring of the NDSS is complicated. A total score is derived by multiplying an individual's response to every item by the factor loading provided in the original NDSS validation article (Shiffman et al., 2004) and then summing each factor-adjusted item score that applies to a specific subscale. Some items are reverses scored and have negative factor loadings. Additionally, a number of items load on multiple subscales and have a positive factor loading on one subscale and a negative factor loadings on other subscales.

The NDSS appears to have strong internal consistency (Cronbach's alpha=0.71-0.83). The total score on the NDSS and four of subscale scores (not Stereotypy) were significantly correlated with smoking rate. Additionally, the NDSS total score significantly predicted urges to smoke, withdrawal during acute abstinence, and cessation outcome (Shiffman, Waters et al., 2004; Shiffman et al., 2005). The multidimensional nature, strong psychometric properties, and theoretical foundation of the NDSS make it a promising measure of nicotine dependence. More research utilizing this measure is necessary before further conclusions can be drawn.

Measures of Nicotine Dependence in African American and Light Smoking Populations

Despite the increase of light smokers in the United States, little is known regarding the reasons why light smokers consume fewer cigarettes, experience difficulty quitting, and maintain their smoking behavior (Fagan & Rigotti, 2009; Shiffman, Dresler, & Rohay, 2004; Shiffman, 2009). The occurrence of light smokers challenges the current measurement strategies employed

in tobacco research (Shiffman, 2009). Measures such as the FTND were developed from samples of heavy smokers where symptoms of physical dependence are prevalent (Shiffman, Kassel, Paty, Gnys & Zettler-Segal, 1994). Light smokers typically score lower on traditional measures of nicotine dependence in comparison to heavy smokers (Etter, Duc, Perneger, 1999; Okuyemi, Pulvers et al., 2007); however, light smokers do report experiencing positive reinforcement from smoking (e.g., socialization, relaxation, and pleasure from smoking) (Shiffman, Paty et al., 1994), feeling a loss of control over smoking behavior (Dierker, Donny, Tiffany, Colby, Perrine, & Clayton, 2007), cigarette craving (Shiffman & Paty, 2006), and difficulty quitting similar to that of heavier smokers (Reitzel et al., 2009). Therefore are light smokers really less nicotine dependent or are the current measurement strategies failing to capture other aspects of nicotine dependence in this population?

Previously noted, African American light smokers smoke fewer cigarettes per day, experience a greater difficulty quitting, and display more tobacco related illness than their Caucasian counterparts. Little is known about the manifestation of nicotine dependence in this population. To date, only one study has explored the use of current nicotine dependence measures in a sample of African American light smokers. Researchers (Okuyemi, Pulvers et al., 2007) examined the psychometric properties of the FTND, the NDSS (Shiffman, Waters et al, 2004), and the CDS (Etter et al., 2003) in a sample of 700 light smoking African Americans (67% female, mean age 45 years). The CDS demonstrated the strongest associations with biochemical markers of cotinine ($r=0.25$) and carbon monoxide breath samples ($r=0.28$), and the five factor structure of the NDSS was maintained in this sample. Mean scores on the FTND was 2.8 ($SD=1.74$), which suggests lower levels of nicotine dependence among African American smokers. Light smokers reported greater dependence on all three scales (FTND=2.99,

CDS=15.7, and NDSS=-0.87) compared to chippers (FTND=2.2, CDS=12.5, NDSS=-1.32), suggesting the general definition of light smoking (10 or fewer cigarettes per day) is not necessarily a homogeneous group.

Wisconsin Inventory of Smoking Dependence Motives (WISDM)

Designed to redress the shortcomings of current nicotine dependence measures, the 68-item Wisconsin Inventory of Smoking Motives (WISDM-68; Piper et al., 2004) was created as a theoretically-based measure to assess dependence in terms of the factors or motives that contribute to compulsive cigarette consumption. More specifically, the WISDM-68 was developed to measure the degree to which certain factors contribute to smoking behavior (Piper et al., 2004). Items on the WISDM-68 were chosen based on constructs from clinical or research settings that are indirectly related to dependence (e.g., smoking to maintain current weight) and may provide new insights into of nicotine dependence (Piper et al., 2006; Piper et al., 2008).

Unlike the FTND, the WISDM-68 assesses nicotine dependence as a multidimensional construct. More specifically, the WISDM-68 examines psychological, physiological, and environmental indicators associated with nicotine dependence (Piper et al., 2004; Piper et al., 2008). The benefit of studying nicotine dependence as a multidimensional construct include; (a) the ability to study variables that may mediate or moderate dependence; (b) the opportunity to measure the developmental time course of nicotine dependence as it occurs during smoking initiation to chronic use; (c) the potential to identify the presence nicotine dependence among populations of smokers where traditional measures fail; (d) the capability of being helpful in treatment settings by identifying barriers to cessation (Baker et al., 2004; Piper et al., 2006).

Each item of the WISDM-68 is rated on a 7-point Likert scale (1=Not true of me at all to 7=Extremely true of me). Ratings are combined into scores on 13 subscales. A brief description

of these subscales is found in Appendix B. The WISDM-68 was first validated with a sample of 775 smokers (303 men, 82% Caucasian) recruited from both community residents and undergraduate students. A total of 443 participants were classified as daily smokers (CPD: M=16.34), and 330 non-daily smokers (CPD; M=2.96). Results from this study suggest that the WISDM-68 possesses adequate internal consistency when dependence is modeled as a multidimensional construct. Moreover, acceptable levels of internal consistency were demonstrated in subpopulations of smokers such as men, women, non-daily, and non-white smokers. Reliability coefficients for these various subpopulations ranged from .73 to .95. Researchers also compared the relationship between different levels of smoking heaviness (i.e., cigarettes per month) and the 13 subscale scores by fitting a nonlinear regression curve to the data. Results from these analyses found two distinct groups of smoking motives based on smoking level. The first group of motives appears present for all smokers, regardless of experience, included: Social-Environmental Goads, Cue-Exposure-Associative Processes, and Taste and Sensory Properties. Motives only influential for heavier smokers or individuals with a lifetime exposure to nicotine included: Craving, Automaticity, Behavioral Choice-Melioration, Cognitive Enhancement, Affiliative Attachment, and Tolerance. The Tolerance subscale was shown to be highly correlated with the FTND, CPD, and carbon monoxide level. Finally, the Automaticity, Cognitive Enhancement, Negative Reinforcement, and Social-Environmental Goads were the best scales for predicting relapse (Piper et al., 2004).

Smith and colleagues (2007) condensed the original 68-item version of the WISDM to reduce survey administration time and to consolidate potentially overlapping subscales. The sample consisted of 579 adult smokers who participated in the original WISDM development study (derivation sample) and 357 additional smokers who completed a phone survey (validation

sample). Researchers first identified three items with the highest factor loadings on each subscale, and then conducted an exploratory factor analysis in the derivation sample. These results were validated using a confirmatory factory analysis of the data from the validation sample. Results indicated a stronger model (CFI=.956, RMSEA=.049) when dropping both the Behavioral Choice Melioration Scale and the Positive Reinforcement Scale. In addition, the Loss of Control and Tolerance subscales were combined. These steps resulted in the 30-item version of the WISDM consisting of 10 subscales. Reliability coefficients for the 10 subscales ranged from 0.60 to 0.93. Descriptions of each of the 10 subscales are as follows:

Affiliative attachment items reflect a tendency for smoker to personify their cigarettes as a friend or close confidant. In doing so, the smoker projects social qualities to their cigarettes, such that smoking becomes reinforcing the similar ways as close relationships (i.e., friends). Further, when quitting many smokers who report experiencing this attachment to their cigarettes also report feeling a social loss or grief related to the relinquishing of this bond (Bott, Cobb, Scheibmeir, & O'Connell, 1997).

Automaticity refers to process in which smoking behaviors become habitualized through repeated practice and performed without conscious awareness of the smoker (Tiffany 1990; Tiffany 1999). Further, these habitualized behaviors automatic processes consist of actions that are highly practiced, executed quickly and effortlessly, and difficult to inhibit once initiated by a smoker(Tiffany 1990; Tiffany 1999).

Craving statements refer to a conscious, subjective experience motivated by a desire to use drugs (Sayette et al., 2000; Tiffany, 1990; Niaura, 2000). Craving may not be a necessary or sufficient cause of drug use; however, drug craving may induce a return to drug use after a cessation attempt (Tiffany, 1990).

Cue exposure/Associative Processes items refer to how stimuli in the environment become associated with smoking behavior or withdrawal in cigarette users. Over time and after repeated pairings, cues such as smoking related paraphernalia, people, places, activities, etc are thought to elicit the urge to smoke (Carter & Tiffany, 1999; Sayette, Martin, Wertz, Shiffman & Perrott, 2001).

Negative Reinforcement subscale reflects smokers' attempts to escape or avoid negative emotional states, prompted by both external stressors and nicotine withdrawal symptoms (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Research pertaining to smoking expectancies and negative affect suggest that smokers engage in smoking behavior in order to achieve an anticipated effect or outcome such as stress reduction and mood management (McKee, Wall, Hinson, Goldstein, & Bissonnette, 2003; Schleicher Harris, Catley, & Nazir, 2009).

Social/Environmental Goads stems from the research pertaining to social networks influence on maintaining smoking behavior among cigarette users. Smokers tend to report greater difficulties in quitting when around other smokers on a regular basis, either occupationally or recreationally, especially when their social network does not support quitting (Paul, Ross, Bryant, Hill, Bonevski, & Keevy, 2010; Westmaas, Wild, & Ferrence, 2002). Smokers have also been found to increase their likelihood of successfully quitting when friends or family have quit or do not smoke (Christakis, & Fowler, 2008; May & West, 2000).

Taste/Sensory Processes subscale assesses the reinforcing effects of smoking derived from sensory experiences such the flavor of cigarettes, the sensation of smoking, or the smell of cigarette smoke. Individuals who experience greater subjective satisfaction from

tobacco use are more likely to experience difficulties with quitting (Rose, Behm, Westman, & Kukovich, 2006; Shiffman, Ferguson, & Gwaltney, 2006). Items on the Tolerance/Loss of Control subscale combine the respondent's perception as to his/her diminished autonomy over tobacco and the concept of tolerance or one's need to increase their cigarette intake to get the desired effect. Two items reflect a smoker's report to feeling addicted to cigarettes after relapsing to smoking reductions in self-efficacy to quit (Scragg, Wellman, Laugesen, & DiFranza, 2008). Further, a marker of tolerance has been related to cigarette consumption immediately upon wakening and linked to smoking relapse (Baker et al., 2007).

Weight Control or maintaining smoking in order to avoid gaining weight has been shown to be related to the maintenance of smoking (Pisinger & Jorgensen, 2007). Research suggests that smokers who report feeling concerned about their weight or body image experience greater difficulty with achieving long term abstinence (Clark, et al., 2006; King, Matacin, White, & Marcus, 2006).

No study to date has examined the psychometric properties of this shorter version of the WISDM in light smoking or ethnic minority samples.

Purpose and Expected Findings

The purpose of the proposed study is to examine the psychometric properties of the 30-item WISDM in a sample of African American light smokers. Specifically, this study addresses the following aims:

1. To determine the factor structure of the WISDM-30 by conducting both an exploratory factor analysis and a confirmatory factor analysis by splitting the sample into a derivation and validation sample.

2. To examine the internal reliability of the WISDM-30 by conducting a Cronbach's alpha statistic for each of the ten subscales.
3. To assess concurrent validity by examining baseline demographic, tobacco-related, and psychosocial correlates with the WISDM-30 total and subscale scores.
4. To compare differences between WISDM-30 subscale scores as well as tobacco related measures in terms of self-reported smoking level.
5. To compare men and women on both the total WISDM-30 score and each of the subscale scores as well as on other tobacco-related measures.

Chapter 3

Methods and Procedures

Participants

The participants of the proposed study were 540 African American light smokers enrolled in a parent study, a randomized, double-blind, placebo-controlled clinical trial of bupropion SR in combination with health education counseling for smoking cessation. To be, study participants had to (a) be African American, age 18 or older, (b) interested in quitting smoking, (c) have smoked 10 or fewer cigarettes per day for at least the past 6 months, (d) have smoked on at least 25 days during the past month, and (f) have a functioning telephone number and home address. Individuals were considered ineligible if they currently used bupropion, other psychoactive medications (e.g., fluoxetine, clonidine), and/or nicotine replacement therapy, or had used any of these drugs in the past month. A history of alcohol or substance abuse within the past year, the occurrence of binge drinking two or more times in the past month (e.g., five or more drinks in one sitting), or the use of other forms of tobacco (e.g., cigars, cigarillos) in the past 30 days also rendered an individual ineligible to participate. In addition, individuals were considered ineligible if they reported a history of seizures, head trauma, bulimia or anorexia nervosa; had a myocardial infarction or stroke in the past 30 days; were currently pregnant or considering pregnancy; were breast feeding; were planning to move from the Kansas City metro area in the next 12 months; or lived with another smoker already enrolled in the study.

Measures

The instruments utilized for the present study consisted of a battery of measures that were administered as part of the parent study. Baseline assessment included items pertaining to basic demographic and descriptive data (i.e., age, gender, marital status, income and education), and

smoking history (i.e., current cigarettes per day, type and brand of cigarettes, description of inhalation method, tobacco use and abstinence history).

Demographic Variables

Demographic characteristics used in the current study included gender, age, education, marital status, income, and employment status.

Tobacco Variables

Assessment of smoking history included age when first smoked, age when started smoking regularly, quitting and relapse history, and reason for most recent relapse.

Questionnaires

The WISDM-30 (Smith et al., 2007) measures motivational domains related to ND. This measure consists of 30 items scored on a 7-point Likert scale (1=Not true of me at all to 7=Extremely true for me). The following 10 subscales are included on the WISDM-30: Automaticity, Craving, Weight Concerns, Negative Reinforcement, Affiliative Attachment, Cue-Exposure/Associative processes, Taste and Sensory Processes, Social-Environmental Goads, Cognitive Enhancement, and Loss of Control/Tolerance. Each subscale is scored by taking the average of all the ratings on the subscale items, and a total score is calculated by summing all the subscale scores. Subscale scores range from 1 to 7 and total scores range from 10 to 70.

The Fagerström Test for Nicotine Dependence, 6 items, is a popular measure designed to test the severity of nicotine dependence among smokers (FTND; Heatherton et al., 1991). Reponses to each item are assigned a particular point value, and total scores are calculated by summing these points. FTND scores range from 0 to 10 points, with 10 points indicative of strong physical dependence to nicotine. This measure has adequate reliability with Cronbach's alpha ranging from 0.56 to 0.63 across various studies (Payne et al., 1994; Okuyemi, Pulvers et

al., 2007). African American light smokers, smoking approximately 1 to 5 cigarettes per day, have an average score of 2.2 (SD=1.7) on the FTND, whereas African American smokers who consume approximately 6 to 10 cigarettes per day scores have an average score of 3.0 (SD=1.7; Okuyemi, Pulvers et al., 2007). Correlations between FTND scores and biochemical markers of dependence have been reported by Okuyemi et al. (2007) on a sample of 700 African American light smokers. The correlations were 0.19 ($p < .001$) with exhaled carbon monoxide and 0.24 ($p < .001$) with serum cotinine. In addition, FTND scores correlated 0.31 ($p < .001$) with cigarettes per day in this study.

The Minnesota Nicotine Withdrawal Scale (MNWS; Hughes & Hatsukami, 1986; Hughes, 1992) is one of the most frequently used measures of nicotine withdrawal in the literature (Shiffman, West, & Gilbert, 2004). Participants completing the MNWS rate the degree to which they have felt withdrawal symptoms (e.g., craving, irritability, anxiety, difficulty concentrating, restlessness, insomnia, increased appetite, and depression), during the preceding 24 hours or during the past 7 days. The number of items on different versions of the MNSW varies from 8 to 14, and all versions use a 5-point Likert scale ranging from 0 (none) to 4 (severe). This study employed the 8-item version of the MNSW. The MNSW is scored by calculating the average rating assigned to the items (Hughes, 1992; Patten & Martin, 1996). Internal consistency (Cronbach's alpha) for the items of the MNSW ranges from 0.71 to 0.87 depending on the version of the test (Cappelleri, Bushmakin, & Baker, 2005). The test-retest reliability for MNSW scores over the span of 24 hours was found to be only 0.39 (West, Ussher, Evans, & Rashid, 2006).

The brief version of the Questionnaire for Smoking Urges (QSU-Brief; Cox, Tiffany, & Christen, 2001) is a self-report measure designed to assess urges and cravings to smoke. The

QSU-brief consists of 10 items, each rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Scores are calculated by averaging the ratings assigned to each item, with higher scores reflecting greater intensity of cravings (Cox et al., 2001). The QSU-Brief can be scored to yield assessments of two craving factors: the first representing a desire to smoke in anticipation of pleasure from smoking, and the second representing an urge to smoke in anticipation of relief from nicotine withdrawal. The QSU-Brief has good internal consistency, with Cronbach's alpha ranging from 0.92 to 0.97 in a laboratory setting and from 0.78 to 0.89 in a clinic setting (Cox et al., 2001; Toll, Katulak, McKee, 2006).

Procedures

The study was conducted at Swope Health Central, a community health center located in Kansas City, MO. Prior to the questionnaire administration, participants were screened for eligibility. Screening interviews were conducted over the telephone or in person when the patient was recruited from the health center. The initial screen consisted of a review of eligibility criteria and provided detailed information about study participation. Eligible individuals were scheduled for a baseline visit within the next two weeks.

Individuals who completed the initial screening were scheduled for their randomization (i.e., baseline visit) at Swope Health Central. Potential participants were reassessed for eligibility during this baseline visit. For those who remained eligible, study procedures and consent forms were reviewed with the individual. Voluntary participation and participant confidentiality were emphasized during the consenting process, and individuals were informed that the decision to participate in the study had no impact upon their current or future care at Swope Health Central. Those who completed consent forms, blood draw, and pregnancy test (women only) were enrolled in the study and are given an identification number. Study participants were then

administered the assessment battery in an interview format, where questions were read aloud to the participants by study staff. The battery was completed in approximately 45-60 minutes.

Data Analysis

Data were entered into SPSS 18.0 for Windows (SPSS Inc., 2010) and analyzed using CFEA (Browne, Cudeck, Tateneni, & Mels, 2009) for exploratory factor analysis and MPlus (Muthen & Muthen, 2010) to conduct confirmatory factor analysis, path analysis, and structural equation modeling. All other analyses were performed using SPSS 18.0. Participant characteristics consisting of categorical variables were summarized by frequencies and percentages while quantitative variables were summarized by means and standard deviations.

Internal Validity. Both an exploratory factor analysis (EFA) and a Confirmatory Factor Analysis (CFA) were conducted to further examine the internal reliability of the WISDM-30 by randomly dividing the sample into a derivation (n =258) and validation sample (n=257). The EFA was calculated using the maximum likelihood factor extraction procedure. The criterion used to determine the number of factors retained was based on eigenvalues > 1, examination of the scree plot, and Horn's parallel analysis. Factors were rotated using an oblique rotation (geomin) to help determine a factor solution.

To conduct the CFA, the correlation matrix was calculated between each of the factors using with a maximum likelihood estimation (Hu & Bentler, 1999). Several statistical tests were performed to determine how well the model fit the data. Both the Comparative Fit Index (CFI) and the Tucker-Lewis Index or the Non-Normed Fit Index (TLI/NNFI) were calculated. Scores for the CFI and TLI/NNFI range from 0 to 1, with larger values indicating a better model fit. An acceptable model fit using CFI and TLI/NNFI scores is considered to be values of 0.90 or greater (Hu et al., 1999; Roberts, 1999). In addition, the Root Mean Square Error of Approximation

(RMSEA) will be conducted to determine model fit. RMSEA scores range from 0 to 1, with smaller values signifying a better model fit. Generally, an RMSEA value of 0.05 or lower indicates good model fit, and an RMSEA of 0.10 or lower indicates acceptable model fit (Hu et al., 1999; Roberts, 1999). Finally, the Standardized Root Mean Square Residual (SRMR) value, which should be less than .08, was calculated to determine if the model a good fit (Hu & Bentler, 1999).

Concurrent Validity. Concurrent validity was examined by conducting Pearson correlations between demographic variables, tobacco-related, and psychosocial correlates with the WISDM-30 total and subscale scores.

Additional Analyses. To determine relationships between smoking level on WISDM subscales as well as tobacco related variables both a path analysis and structure equation modeling (SEM) techniques were employed. First the derivation sample was used to run a path analysis to determine the relationship between multiple IV's (i.e., WISDM subscales, tobacco related variables, tobacco related questionnaires) on a DV (i.e., smoking level) (Browne, 2008). Further, SEM provides a general framework for evaluating the relationships among many variables while taking into account the relationships between variables and error variance (Browne, 2008). A similar procedure was performed to assess the relationship between gender on WISDM subscales as well as tobacco related variables Finally as a further indication of concurrent validity, independent sample t-tests was used to compare men and women on the WISDM-30 subscale scores, tobacco related variables, and tobacco questionnaires.

Chapter 4

RESULTS

Participant Characteristics

A total of 540 individuals completed the baseline assessment. Of these, 25 individuals were excluded from the analyses because their reported smoking level was greater than 10 CPD. There was no missing data. Participant characteristics are presented in Table 1. The majority of the sample was female (66.4%), single (68.7%), and employed (55.3%). Participant ages ranged from 19 to 80, with an average age of 46.2 (SD = 11.3). Eighty-four percent of participants reported having at least a high school education, and approximately 60% reported income earnings over $1800 per month. Participants reported smoking an average of 7.6 CPD (SD=2.4), making 3.7 (SD = 7.7) 24-hour quit attempts in the past year, and smoking for about 25.1(SD = 12.2) years. Seventy-one percent of participants reported smoking within 30 minutes of awakening in the morning. In addition, participants scored an average of 3.1 (SD = 1.7) on the FTND, 9.6 (SD = 6.8) on the MNWS, and 2.9 (SD = 1.7) on the QSU-Brief. WISDM-30 total scores ranged from 15 to 68, with subscale scores ranging from 1 to 7. Average scores on the WISDM-30 total and subscales are reported in Table 2.

Exploratory factor analysis

Determining the number of factors

As stated in Aim 1, an EFA, using CEFA v. 2.0 (Brown, Cudeck, Tateneni, & Mels, 2008), was employed to determine the initial factor structure of the WISDM-30 among this sample of African American light smokers. Participants were randomly divided into a derivation group (n=258) and a validation group (n=257), with the derivation groups data being used for the EFA. After obtaining an un-rotated factor matrix, several methods were implemented to

determine the number of factors for inclusion in the EFA analysis. First, a scree plot was used to establish the number of potential factors by plotting the eigenvalues of the correlation matrix in descending order. The number of eigenvalues that occur prior to the last major drop in eigenvalue magnitude suggests the number of factors to be retained. A break in slope was seen between five and six, suggesting a total of five factors (see Figure 1). Second, the Kaiser criterion which suggests the number of factors is the same as the frequency of eigenvalues greater or equal to one, identified a total eight factors (see Table 3). Third, a parallel analysis results supported a 5-factor model. Finally, fit indices and item loadings were compared across models with five, six, seven, eight, and nine factors (see Table 4). While a 9-factor model produced the lowest fit indices (RMSEA=0.031), the 8-factor model obtained items appeared theoretically more logical and had fewer cross loadings.

EFA Results

An oblique extraction using a geomin rotation was administered to the WISDM-30 to improve interpretability of the un-rotated solution. The 8-factor model replicated seven of the factors originally reported by Smith and colleagues (2007) for the WISDM-30 (e.g., Affiliative Attachment, Automaticity, Cognitive Enhancement, Negative Reinforcement, Social Support, Taste/Associative Processes, and Weight Loss). The final factor consisted of the original three craving items plus two items from the Tolerance/Loss of Control subscale as well as one item from the Cue Reactivity subscale. Table 5 presents the factor loadings and items on each factor.

In addition to combining three of the subscales (Craving, Tolerance/Loss of Control, and Cue Reactivity), a total of three items were excluded after failing to load on any factor. Two items related to mood cross-loaded with the Cognitive Enhancement subscale. Both of these items loaded higher on Factor 2 (Negative Reinforcement), thus were retained on that factor.

Table 6 contains the list of problematic items. As a result of the EFA analysis, the version of the WISDM-30 that emerged as a result of the present EFA is subsequently referred to here as the WISDM-27.

Additionally, a second order EFA was conducted to determine if each of the eight factors loaded on a single higher order factor. Again the chi-square test was significant (χ^2 (*df* = 20) = 40.82, p<.001); however, all other results suggest the eight subscales are related to a single factor, as indicated by the RMSEA fit indices [RMSEA = 0.064 (CI 90% = 0.035-0.92)].

Confirmatory Factor Analysis

Using the validation sample (n = 257), the 8-factor model of the WISDM-27 was used to calculate the CFA with a maximum likelihood extraction procedure. The chi-square for the eight factor model was significant (χ^2 (*df*= 296) = 421.94, p<.001). This result indicates a lack of fit with the model emerging from the EFA; however, the chi square statistic is likely to be inflated by large sample sizes. Other indices suggested the model fit the data extremely well: RMSEA: 0.041 (90% CI 90% = 0.031-0.049); SRMR =0.046; CFI = 0.953; and TLI = 0.944. This provides strong support for the utilization of an 8-factor model with 27 items for the WISDM among African American light smokers. Additionally, a second order CFA was conducted to determine if each of the eight factors loaded on a single higher order factor. Again the chi-square test was significant (χ^2 (*df* = 316) = 462.67, p<.001); however, all other results suggest the eight subscales are related to a single factor, as indicated by the following fit indices: RMSEA = 0.042 (CI 90% = 0.034-0.051); SRMR = 0.055; CFI = 0.945; and TLI = 0.939. Parameter estimates for the CFA results are presented in Table 7 while the parameter estimates for the second order CFA are presented in Table 8.

Internal Reliability

Aim 2 focused on examining the internal reliability of the WISDM-30, and was conducted using Cronbach's alpha for each of the original WISDM-30 subscales, as well as for the WISDM-27 subscales identified in this study. Cronbach's alpha is calculated by averaging the correlation coefficients between items. Scales or subscales with an alpha great then 0.7 are considered to have good internal reliability. Table 9 contains all Cronbach alphas for both the WISDM-30 and WISDM-27. The lowest Cronbach alpha scores on the WISDM-30 subscales were on the Cue-Exposure/Associative Processes and Tolerance/Loss of Control Subscales (.608, .604) while the Craving subscale of the WISDM-30 was 0.778. When combined into the WISDM-27, the new Craving subscale alpha is 831. Internal reliability was improved when subscales were combined as suggested by results from the EFA and CFA.

Concurrent Validity

Aim 3 proposed an assessment of the concurrent validity of the WISDM-30 by examining the correlates between baseline demographic and tobacco-related variables with the WISDM-30 subscales. Given the results from both the EFA and the CFA, this aim was adjusted to incorporate the subscales proposed by the WISDM-27. Bivariate correlations among the eight WISDM-27 subscales were calculated, and moderate and significant associations are seen between the Affiliative Attachment and Cognitive Enhancement subscales ($r = .518$, $p<.001$) as well as the Affiliative Attachment and Negative Reinforcement subscales ($r = .505$, $p<.001$). Additionally, the Cognitive Enhancement and Craving subscales ($r = .507$, $p<.001$) were found to be moderately correlated. The strongest associations were seen between the Negative Reinforcement and Cognitive Enhancement subscales ($r = .702$, $p<.001$) and the Craving and

Negative Reinforcement subscales (r = .550, p<.001). Correlations between all of the 8 WISDM-27 scales are in Table 10.

As reported in Table 11, none of the WISDM-27 subscales were correlated to baseline demographic characteristics (e.g., age, gender, education level, marital status, income, and employment status). The Craving subscale of the WISDM-27 was to both Factor 1 of the QSU-Brief, which is characterized as the anticipation of the pleasurable effects of smoking (r = .532, p<.001) and to Factor 2 of the QSU-Brief which assesses smoking as a means of relieving the negative effects of craving (r = .461, p<.001).

Correlations between the WISDM-27 subscales and the FTND were all weak, ranging from .009 to .327. Additionally, the CPD (.010 to .324), TTFC (-.008 to -.232), age at which the subject smoked regularly (.010 to -.139), number of quit attempts in the past year (.006 to .084), number of years smoked (.012 to -.053), and withdrawal (.108-.321) were also not associated with any of the WISDM-27 subscales. A complete listing of all bivariate correlations between WISDM-27 subscales and tobacco related variables is found in Table 12.

Participant Characteristics by Smoking Level

Aim 4 compared differences between WISDM-27 subscale scores and tobacco related measures based on of self-reported smoking level (e.g., number of cigarettes smoked on average over the last seven days). Using the validation sample (n=257), two separate SEM models were conducted: one with all eight WISDM-27 subscales and one with the tobacco related variables such as withdrawal, nicotine dependence, smoking urge, duration of smoking, age at which the subject started smoking regularly, number of quit attempts in the past year, and number of years smoked. Time to first cigarette in the morning was included in the analysis; however, because it was a categorical variable, fit indices could not be provided. A path analysis using the derivation

sample (n=258) was conducted looking at both the WISDM-27 subscales and tobacco related variables. The path analysis served as a means of replicating the results from the SEM models.

SEM for Smoking Level and WISDM-27 Subscale Scores

The chi-square for the SEM model fitting WISDM-27 subscale scores predicted by smoking level was significant (χ^2 (df = 315) = 3122.36, p<.001); here again, the large chi square is likely attributable to the large sample size. Other indices of model fit suggested the model fit the data extremely well: RMSEA: 0.041 (90% CI 90% = 0.032-0.049); SRMR =0.046; CFI = 0.951; and TLI = 0.941. Parameter estimates suggest the following subscales were affected positively by smoking level: Affiliative Attachment Automaticity, Cognitive Enhancement, and Craving. Table 13 contains all parameter estimates for each of the 8-WISDM-27 subscales and Figure 2 displays the path diagram for this analysis.

SEM for Smoking Level and Tobacco Related Variables

Fit indices for the SEM model examining smoking level and tobacco related variables are not provided due to the inclusion of the TTFC categorical variable (e.g., $\leq$ 30 minutes, >30 minutes) Parameter estimates can be found in Table 14. According to the model, only the FTND (p<.001) and TTFC were significant in this model, suggesting that differences in these measures of nicotine dependence contribute to differences in smoking level among the current sample of light smokers. Figure 3 portrays the path diagram for this analysis.

Path Analysis for Smoking Level, WISDM-27 Subscales, and Tobacco Related Variables

Fit indices for the path analysis could not be determined due to the inclusion of the categorical TTFC variable. Results replicated the findings of the SEM models, and all parameter estimates can be found in Table 15 and a path diagram in Figure 4. Specifically the Affiliative Attachment, Automaticity, Cognitive Enhancement, and Craving subscales of the WISDM-27

were associated with smoking level. Additionally, the FTND and TTFC were the only tobacco related variables associated with increases in smoking level.

Findings by Gender

Aim 5 was concerned with differences between men and women on WISDM-27 subscale scores as well as other tobacco related measures (e.g., FTND, TTFC, MNWS, QSU-brief, number of years smoked, number of quit attempts in the past year, and age started smoking regularly). Two separate SEM models were run with the validation sample (n=257), one with all 8 WISDM-27 subscales and one with the tobacco related variables. A path analysis containing all WISDM-27 subscales and tobacco related measures was also employed with the derivation sample (n=258) to determine if the SEM results were replicated in a separate sample.

T-Test Results for Gender, WISDM-27, and Tobacco Related Variables

Independent t-tests were also used to detect differences between men and women on WISDM-27 subscale scores as well as the tobacco related variables. Gender differences were seen initially on the Social/Environmental Goads and Weight Control subscales of the WIDSM-27. However, following Bonferoni correction, none of the gender differences from the t-test analyses were significant. A complete listing of differences can be found in Table 21.

SEM for Gender and WISDM-27 subscales

The chi-square for the SEM model fitting WISDM-27 subscale scores predicted by gender was significant (χ^2 (*df* = 378) = 3113.70, p<.001) and likely significant due to the large sample size. Other indices of model fit suggested the model fit the data extremely well: RMSEA: 0.043 (90% CI 90% = 0.035-0.051); SRMR =0.046; CFI = 0.945; and TLI = 0.934. Social/Environmental Goads and Weight Control were the only WISDM-27 subscales to be affected by gender. Men (M=4.18) reported higher scores than women (M=3.71) on the Social

Influences subscale, while women (M=2.42) reported higher scores on the Weight Control subscale then men (M=2.08). Parameter estimates for all of the WISDM-27 subscales and gender can be found in Table 18 and are visually depicted as a path diagram in Figure 4.

SEM for Gender and Tobacco Related Variables

Fit indices for the SEM model examining smoking level and tobacco related variables are not provided due to the inclusion of the TTFC categorical variable. Parameter estimates are located in Table 19 and visually represented in a path diagram in Figure 5. Only number of years smoked significantly differed between men and women, with men reported smoking longer (M=26.91 years) than women (M=24.12 years).

Path Analysis for Gender, WISDM-27 Subscales, and Tobacco Related Variables

Fit indices for the path analysis could not be determined due to the inclusion of the categorical TTFC variable. Results did not replicate the findings of the SEM models, none of the parameter estimates in the path analysis were significant (see Table 20 and Figure 6). This discrepancy between the SEM models and path analysis is unclear; however, data suggests that gender did not contribute to differences in WISDM-27 scores or scores on other tobacco related measures.

Chapter 5

DISCUSSION

The current study was the first to explore motivational processes of nicotine dependence using the WISDM among African American light smokers. This study examined the psychometric properties of the WISDM-30 (Smith et al., 2007) among a sample of 515 African American light smokers. Unlike the WISDM-30 which has a 10 factor solution, results from both an EFA and CFA analysis suggest a 27-item version of the WISDM with 8 subscales was the best solution to evaluate nicotine dependence in this sample. In addition, all 8 subscales were found to load on a single higher order factor, indicating each of these areas measures a unified construct.

WISDM-27 Factor Structure

Supported by both EFA and CFA analyses, an 8-factor model with 27 items adequately measured smoking motivations among African American light smokers. The WISDM-27 retains seven of the ten subscales found in the WISDM-30 (Smith et al., 2007), with each subscale containing three items. Furthermore, all three of the original Craving items as well as three additional questions from the Tolerance/Associative Processes and Cue-Reactivity subscales created a new 6-item Craving subscale. Three items from the WISDM-30 were excluded from the WISDM-27 after failing to load on any factor: "If I always smoke in a certain place it is hard for me to be there and not smoke"; "There are particular sights and smells that trigger strong urges to smoke"; and "I smoke within the first 30 minutes of awakening in the morning".

Researchers have found the Tolerance, Craving, Automaticity, and Loss of Control subscales of the WISDM-68 to be strongly associated with relapse vulnerability, withdrawal, and urge strength among heavy smokers (Baker et al., 2009; Piper et al., 2008, Smith et al., 2010).

These primary dependence motives were characterized as "necessary and sufficient features of dependence" (Baker et al., 2009 pg. 94) that represent persistent, heavy smoking patterns (Baker et al., 2009). Following this reasoning, light smoking populations theoretically should not strongly endorse items from these subscales due to a lack of heavy cigarette consumption. Previous research supports this hypothesis. For example, other studies find light and intermittent smokers to report fewer symptoms of withdrawal compared to heavier smokers (Shiffman, Paty, et al., 1994; Shiffman & Paty, 2006. Additionally, light and intermittent smokers have reported lower WISDM-68 subscale scores on the primary dependence scales of the WISDM-68 compared to moderate and heavy smokers (Reitzel et al., 2009; Piper et al., 2004).

Model fit was improved on the WISDM-30 by combining the Tolerance and Loss of Control subscales of the WISDM-68, which inhibited replication of the primary dependence motives in this study. However, the combination of craving, tolerance, and cue reactivity items on the Craving subscale of the WISDM-27 challenge the role of smoking heaviness in nicotine dependence. Both craving and tolerance are thought to be constructs more prevalent in heavy smoking populations (Baker et al., 2009), yet participants in the current sample of light smokers reported experiencing symptoms of craving and feeling addicted to cigarettes. In this sample, the Craving subscale had the highest score of all eight WISDM-27 subscales, suggesting participants experienced moderate difficulties with cigarette craving or smoking urge.

It is noted that all of the WISDM-27 subscale scores are generally lower in comparison to WISDM-30 subscale scores reported in a sample of heavy smoking Caucasians (Smith el al., 2007). The scoring on both brief versions of the WISDM are based off a 7-point Likert scale ranging from 1="Not true of me" to 7="Extremely true of me". None of the subscale score averages were above a five, suggesting that many of the motives were not strongly endorsed in

this sample. Current literature suggests that constructs such as Weight Control, which has generally not been reported as a reason for smoking or concern related to cessation among African American smokers, would not be expected to serve as a strong motivator for smoking (Nollen et al., 2006; Thomas, et al., 2008; Thomas et al., 2009) in this sample. Other low WISDM-27 subscale scores also had high standard deviations, suggesting heterogeneity in responding individual and their motivation to smoke.

Reasons for the variability are unclear. Perhaps a subset of light smoking African Americans appear more similar to that of heavy smoking Caucasians. For instance, the length of smoking history, even at lower rates, establishes a behavioral pattern that differs between chronic light smokers and emerging smokers. Data pertaining to the smoking trajectories of African American smokers shows that many African Americans will initiate tobacco use later in age and consistently smoke fewer cigarettes per day compared to Caucasian smokers who will increase their cigarette intake over time (Trinidad et al., 2004; White, Nagin, Replogle, & Stouthamer-Loeber, 2004). Therefore, these chronic light smokers potentially may develop primary dependence motives, even at a lower rate, despite smoking fewer cigarettes per day. A possible explanation is that slower nicotine metabolism has been associated with lower rates of smoking, especially among African Americans, leaving the body exposed to nicotine for a longer period of time (Tyndale & Sellers, 2001; Perez-Stable, Herrera, & Jacob, Benowitz, 1998). These slow metabolizers would need to consume fewer cigarettes to experience the effects of nicotine similar to heavy smokers (Tyndale et al, 2001).

Smoking level has been thought to be a primary feature of nicotine dependence, and the basis for how dependence has been conceptualized and treated in the literature (Piper et al., 2006, Baker et al., 2009). A “one size fits all approach” to understanding nicotine dependence may

ignore salient features, such as craving, present among this heterogeneous groups of smokers. Future studies should focus on the examination of craving as well as additional primary dependence motives among light smoking populations to determine their contribution to quit status and their role in the maintenance of nicotine dependence. Smoking within 30 minutes of awakening in the morning, as measured on the FTND, has been found to a predictor of smoking relapse and an indicator of nicotine dependence among smokers (Baker et al., 2007). Seventy-two percent of the current study sample reported smoking within the first 30 minutes of wakening as indicated within the FTND; however, factor analysis results found that the Time to First Cigarette-related item from the WISDM-30 did not load on any of the eight factors. Reasons for this remain unclear. The Time to First Cigarette item pertains to more traditional theories of nicotine dependence that emphasize the importance of tolerance and withdrawal. In contrast, the WISDM-27 reflects latent constructs with contribute to the motivation to maintain smoking behavior. Therefore, these two items may be assessing different aspects of dependence. An alternative explanation is that Time to First Cigarette may not be linked to nicotine dependence among light smokers in the same way as populations. For instance, light smokers may be smoking within 30 minutes of awakening due to anticipation of work place smoking restrictions or indoor smoking bans, rather than attempting to alleviate withdrawal by boosting nicotine levels in the blood stream. Similarly, smoking first thing in the morning may improve one's concentration, affect, or energy level rather than reducing withdrawal symptoms due to nicotine deprivation among light smokers provide positive reinforcement rather than negative reinforcement.

Multidimensional Nature of the WISDM-27

Piper and colleagues have advocated for the use of multidimensional measures of nicotine dependence in order to go beyond physical characteristics of dependence by incorporating psychological aspects of nicotine dependence (Piper et al., 2004, 2008). Previous research has supported a theory of nicotine dependence that is multifaceted (Clark, Wood, Martin, Cornelius, Lynch, & Shiffman, 2005; Etter, 2005; Piper et al., 2008; Shiffman et al., 2004, Shiffman, Paty et al. 2005). Results from both the EFA and CFA continue to support the hypothesis of a multidimensional approach to conceptualizing nicotine dependence. Interestingly, the second order EFA and CFA suggests that all the 8 subscales of the WISDM-27 load onto a common factor, suggesting a single construct. This also supports Piper and colleagues hypotheses that multiple underlying motivations relate to the overall construct of nicotine dependence (2004, 2006, 2008).

Internal Reliability

Cronbach's alpha measures how each item in a subscale correlates with the sum of the remaining items as well as provides an estimate of constancy in responses (Cronbach, 1951; Cronbach & Shavelson, 2004). Initially on the WISDM-30, the lowest Cronbach alpha scores on the WISDM-30 subscales were found on the Cue-Exposure/Associative Processes ($\alpha = .608$) and Tolerance/Loss of Control Subscales ($\alpha = .604$). Additionally, the Craving subscale of the WISDM-30 had a Cronbach's alpha of .778. When these subscales were combined on the WISDM-27, the new Craving subscale had an alpha of 0.831. Therefore, internal reliability was improved, further providing support to the results obtained in the EFA and CFA analyses showing a combined subscale.

Concurrent Validity

The strongest association between WISDM-27 subscales was seen between the Negative Reinforcement and Cognitive Enhancement subscales. Items on the Negative Reinforcement subscale focus on using smoking to relieve negative affective states, while the Cognitive Enhancement subscale consists of items measuring the use of smoking to improve one's focus and attention (Piper et al., 2004, 2008). Previous research has shown negative mood states and difficulty concentrating as symptoms of nicotine withdrawal (Hughes & Hatsukami, 1986; Hughes, 1992, 2007). Nicotine deprived smokers have shown increases in self-reported negative affect as well as greater cognitive impairments on tests of attention and memory, that are reversed when smokers are allowed to smoke or are administered nicotine (Heishman, Kleykamp, & Singleton, 2010; Myers, Taylor, Moolchan, & Heishman, 2008). Additionally, African American light smokers report smoking to improve mood and concentration (Jeffries, Cately, Okuyemi, Nazir, McCarter, Grobe, & Ahluwalia, 2004; Thomas, et al., 2009). Assessing the reinforcing effects of smoking to improve negative mood and concentration as a barrier to cessation among African American light smokers is warranted.

The Craving and Negative Reinforcement subscales of the WISDM-27 had a moderate, positive association; this finding is consistent with previous studies (Baker et al., 2004; Shiffman, Hickcox, Paty, Gnys, Richards et al., 1997; Tiffany, 1990). Depressive states post cessation have been linked to smoking relapse among African American smokers (Cately, Harris, Okuyemi, Mayo, Pankey, & Ahluwalia, 2005), while another study found reductions in self-reported craving and improvements in negative mood states immediately after smoking (Carter et al., 2008). In addition, the Cognitive Enhancement and Craving subscales were found to be moderately correlated. Craving has been shown to negatively impact attention during withdrawal

states (DiFranza & Wellman, 2005; Hendricks, Ditre, Drobes, & Brandon, 2006; Hughes, 2007), suggesting the relationship between these two subscales is consistent with the current literature.

A relationship between the Affiliative Attachment and Negative Reinforcement subscales was found. Previous literature has suggested both poor social support and depressed mood negatively impact cessation (Strine, Chapman, Balluz, & Mokdad, 2000; Westmaas et al., 2010). Romano and colleagues (1991) found African American women with few social support networks were 3 times more likely to smoke compared to women with greater social support. Nollen et al. (2005) found both African American men and women with greater reported social support were more likely to be quit at follow up than those that report less social support. Perhaps individuals with greater social support networks may report less negative affective states, thus decreasing the impact of nicotine dependence.

Correlations between the WISDM-27 and the FTND were weak and ranged from 0.099 to 0.394. Previous research has also shown a weak relationship between the FTND and WISDM-68 (Piper et al. 2004, 2008; Smith 2010), most likely because the FTND is limited to physical characteristics of nicotine dependence. In addition, WISDM-27 subscales were not strongly related to CPD, number of years smoked, number of prior quit attempts, time to first cigarette, or any of the demographic variables.

Finally, the Craving subscale of the WISDM-27 is moderately related to the QSU-Brief total score in addition to both Factor 1 and Factor 2 subscales of the QSU-Brief. The effect of cigarette craving on smoking behavior among African American light smokers is unclear due to a lack of evaluation in the literature. Carter and colleagues (2010) found heavy smoking African Americans to report stronger cigarette cravings than their White counterparts. Whether this relationship can be seen in light smoking populations merits further investigation. Participant

responses on the QSU-Brief and the Craving subscale of the WISDM-27 suggest craving may play a moderate role in smoking motivation among African American light smokers.

WISDM-27 Subscales, Tobacco-Related Variables, and Smoking Level

The Automaticity and Craving subscales of the WISDM-27 were associated with smoking level. Automaticity refers to the behaviors involved in acquiring and consuming cigarettes that, over time and through repeated practice, become habitual and performed without the conscious awareness of the smoker. These automatic processes consist of actions that are highly practiced, executed quickly and effortlessly, and difficult to inhibit once initiated, and they have been strongly linked to heavier smoking patterns (Baker et al., 2009; Tiffany 1990; Tiffany 1999; Smith et al., 2010). Further, craving strength has been linked to increased levels of blood cotinine levels (DiFranzia et al., 2005; Jarvik et al., 2000), withdrawal intensity symptoms (Klein & Eissenberg, 2003; Hughes, 2007) and relapse among individuals attempting to quit (Shiffman, Paty et al., 1996; Swan, Ward, & Jack, 1996; Shiffman et al., 1997; Allen, Bade, Hatsukami, & Center, 2008). Interestingly, despite smoking less, African American light smokers report experiences of automaticity and craving even at lower levels of smoking.

WISDM-27 Subscales, Tobacco-Related Variables, and Gender

Results from both the SEM model and the path analysis found that seven of the WISDM-27 subscales did not differ significantly by gender. The Social Support subscale was significantly different between men and women according to the SEM model but not the path analysis. Previous studies have demonstrated gender differences with regards to pharmacotherapy effectiveness, with men having more success quitting with nicotine replacement therapies while women benefit more from antidepressant medications (Perkins et al., 1999, 2001, 2009; Wetter et al., 1999). Further, predictors of cessation also have differed between men and women. For

instance, men report greater tolerance, withdrawal, and alcohol use as barriers to quitting, while women report weight concerns and negative affect as impediments towards cessation (Piper et al., 2001; Westmaas et al., 2005). Perkins suggests the reinforcing effects of nicotine differ between men and women, with women being influenced less by nicotine and more affected by non-nicotine factors (2008, 2009). Given previous findings in the literature, women would be expected to score higher on the Negative Reinforcement, Affiliative Attachment, and Social/Environmental Goads subscales of the WISDM-27 than men (Smith et al., 2010). However, results from this study found a lack of gender differences. The unclear findings in this study related to gender and nicotine dependence warrant further investigation to determine if this is common among African Americans, light smokers, or both.

Strengths and Limitations

Results are limited in their generalizability to other smoking populations (e.g., Latino smokers, adolescent smokers). Future research examining the WISDM among different subsets of smokers would be beneficial in further understanding the role of nicotine dependence in maintaining smoking behavior. In addition, biochemical verification of smoking status to ensure smoking level was not utilized in this study, and instead was based on self-reported smoking level. Smoking status was verified several times throughout the screening and assessment process, suggesting participants self-report to be accurate. Finally, the study consisted of treatment seeking smokers. Whether results were affected by participants' motivation to quit is unclear. Future research regarding cessation motivation and nicotine dependence would provide a better understanding of the potential impact of this relationship.

The current study examined the psychometric properties of the WISDM-30 in a sample of African American light smokers and found an abbreviated 27-item version of the WISDM to adequately identify factors related to nicotine dependence. Previous measures of dependence have classified African Americans light smokers as less dependent, despite their difficulty with quitting smoking successfully. The growing phenomenon of light and intermittent smokers challenges the physiological model of dependence, which base the maintenance of smoking behavior on constructs such as tolerance and withdrawal. More simply, if smoking cessation was based on tolerance and withdrawal alone, then light smokers should not experience difficulty quitting. Given the struggles seen in this population, other psychological factors sustaining smoking behavior must be present.

Results from this study provide information regarding characteristics of nicotine dependence and factors related to smoking behaviors of African American light smokers. Further, this subset of smokers did report aspects of nicotine dependence thought to be seen predominately among heavy smoking populations. African American light smokers from this study reported experiences of craving as a motivational factor in sustaining smoking behavior as well as sensory processes and negative affect.

Identifying factors associated with smoking among these high-risk smokers may assist in developing effective smoking cessation interventions. Additionally, further elucidating the impact of smoking motivations such as craving and automaticity on smoking behavior as it pertains to nicotine dependence would contribute to understanding the difficulties African American light smokers face when quitting.

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Table 1: Participant Characteristics

	Total 515
Demographic Variables	
Age, mean (SD) yr	46.2 (11.3)
Women, n (%)	342 (66.4)
Married or living with partner, n (%)	161 (31.3)
Monthly family income < $1800, n (%)	199 (39.8)
Education > High school, n (%)	436 (84.7)
Employed full time, n (%)	203 (39.4)
Tobacco Related Variables	
Cigarettes per day, mean (SD)	7.6 (2.4)
Age of first cigarette , mean (SD) yr	17.8 (6.7)
Age started smoking regularly, mean (SD) yr	21.3 (7.7)
Number of years smoked, mean (SD) yr	25.1 (12.2)
Number of previous 24 hour quit attempts in the past year, mean (SD)	3.7 (7.7)
Longest number of days quit in the past year, mean (SD) days	57.6 (156.6)
Longest number of days quit, lifetime, mean (SD) days	401.0 (917.8)
FTND, mean (SD)	3.1 (1.7)
Time to first cigarette, <30 minutes, mean (SD)	369 (71.7)
MNWS, mean (SD)	9.6 (6.8)
QSU-Brief total score, mean (SD)	2.9 (1.7)
QSU-Brief factor 1 score, mean (SD)	3.5 (2.0)
QSU-Brief Factor 2 score, mean (SD)	2.2 (1.5)

Table 2: WISDM-30 and WISDM-27 Total and Subscale Scores, Means and Standard Deviation

	Total 515
WISDM-30 Total Score	36.8 (11.1)
Affillliative Attachment	2.9 (1.8)
Automaticity	3.6 (1.8)
Loss of Control/Tolerance	4.9 (1.6)
Cognitive Enhancement	2.9 (1.8)
Craving	4.3 (1.7)
Cue Exposure/Associative Processes	4.4 (1.7)
Negative/Reinforcement	3.6 (1.8)
Social/Environmental Goads	3.9 (2.1)
Taste/Sensory Processes	4.0 (1.9)
Weight Control	2.3 (1.6)
WISDM-27 Subscale Scores	
Affillliative Attachment	2.9 (1.8)
Automaticity	3.6 (1.8)
Cognitive Enhancement	2.9 (1.8)
Craving	4.6 (1.5)
Negative/Reinforcement	3.6 (1.8)
Social/Environmental Goads	3.9 (2.1)
Taste/Sensory Processes	4.0 (1.9)
Weight Control	2.3 (1.6)

Table 3. Eigenvalues Derived from Unrotated Factor Matrix

8.854	0.7109	0.3549
2.306	0.6470	0.3308
2.190	0.6109	0.3146
1.899	0.5851	0.3006
1.751	0.5609	0.2715
1.332	0.4778	0.2662
1.132	0.4598	0.2262
1.009	0.4418	0.2044
0.8560	0.4120	0.1778
0.7977	0.3898	0.1298

Eigenvalues meeting Kaiser Criterion are bolded

Table 4. EFA Fit Indices for WISDM-30 Factor Loadings

Number of factors	Chi Square	Chi-Square df	P value	RMSEA	RMSEA 90% Confidence Interval
5	764.78	295	<.001	0.079	0.072-0.086
6	561.34	270	<.001	0.065	0.057-0.072
7	425.79	246	<.001	0.053	0.045-0.062
8	300.64	223	<.001	0.037	0.025-0.047
9	249.11	201	<.001	0.031	0.015-0.042

Table 5: EFA Factor Loadings

Factor 1: Cognitive Enhancement		
Item #	Item	Factor Loading
11	Smoking helps me stay focused	.571
19	My concentration is improved after smoking a cigarette	.748
27	Smoking helps me think better	.818
Factor 2: Negative Reinforcement		
Item #	Item	Factor Loading
28	Smoking really helps me feel better if I've been feeling down	.397
8	Smoking helps me feel better in seconds	.497
5	Smoking a cigarette improves my mood	.533
Factor 3:Affiliative Attachment		
Item #	Item	Factor Loading
9	Cigarettes keep me company, like a close friend	.525
30	Giving up cigarettes would be like losing a good friend	.531
20	I would feel alone without my cigarettes	.559
Factor 4: Taste/Sensory Processes		
Item #	Item	Factor Loading
13	Most of my daily cigarettes taste good	.746
1	I enjoy the taste of cigarettes most of the time	.811
6	The flavor of a cigarette is pleasing	.856
Factor 5: Weight Control		
Item #	Item	Factor Loading
2	Smoking keeps me from gaining weight	.636
7	I rely upon smoking to control my hunger and eating	.698
16	Weight control is a major reason I smoke	.760
Factor 6: Automaticity		
Item #	Item	Factor Loading
26	Sometimes I am not aware that I am smoking	.525
4	I often smoke without thinking about it	.632
12	I frequently light cigarettes without thinking about it	.726

Factor 7: Craving		
Item #	Item	Factor Loading
14	I frequently crave cigarettes	.437
23	When I do certain things I know I'm going to smoke	.499
29	I consider myself a heavy smoker	.534
22	When I haven't been able to smoke for a few hours, the craving gets intolerable	.626
17	I'm really hooked on cigarettes	.674
18	My urges to smoke keep getting stronger if I don't smoke	.727
Factor 8: Social Environmental Goads		
21	A lot of my friends or family smoke	.720
15	Most of the people I spend time with are smokers	.825
24	Most of my friend s and acquaintances smoke	.987

Table 6: Problem Items from EFA Results

Item	Factor Loading	Description of Problem
If I always smoke in a certain place it is hard for me to be there and not smoke	.201 (F2) & .262 (F7)	Does not really load
Smoking a cigarette improves my mood	.488 (F1) & .533 (F2)	Cross loads
There are particular sights and smells that trigger strong urges to smoke	.308	This does not seem like an appropriate item on Factor 2
I smoke within the first 30 minutes of awakening in the morning	.350 on Factor 7	Did not load at all
Smoking really helps me feel better if I've been feeling down	.335 (F1) & .397 (F2)	More appropriate item for Factor 2, but low and close to factor loading on Factor 1

Table 7: Confirmatory Factor Analysis Results

Items	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Affiliative Attachment				
Cigarettes keep me company like a close friend.	1.626	0.113	0.0001	0.727
I would feel alone without my cigarettes.	1.696	0.111	0.0001	0.826
Giving up cigarettes would be like losing a good friend.	1.379	0.142	0.0001	0.702
Automaticity				
I often smoke without thinking about it.	1.446	0.138	0.0001	0.649
I frequently light cigarettes without thinking about it.	1.773	0.146	0.0001	0.791
Sometimes I am not aware that I am smoking.	1.265	0.147	0.0001	0.604
Cognitive Enhancement				
Smoking helps me stay focused.	1.655	0.094	0.0001	0.853
My concentration is improved after smoking a cigarette.	1.719	0.091	0.0001	0.841
Smoking a cigarette helps me think better.	1.668	0.103	0.0001	0.841
Craving				
I frequently crave cigarettes.	1.478	0.091	0.0001	0.780
I'm really hooked on cigarettes.	1.253	0.106	0.0001	0.675
My urges to smoke keep getting stronger if I don't smoke	1.396	0.105	0.0001	0.709
When I haven't been able to smoke for a few hours, the craving gets intolerable.	1.450	0.104	0.0001	0.712
When I do certain things I know I'm going to smoke.	1.134	0.101	0.0001	0.605
I consider myself a heavy smoker	1.311	0.115	0.0001	0.602
Negative Reinforcement				
Smoking a cigarette improves my mood	1.575	0.114	0.0001	0.722
Smoking helps me feel better in seconds.	1.595	0.105	0.0001	0.736
Smoking really helps me feel better if I've been feeling down.	1.522	0.113	0.0001	0.737
Social/Environmental Goads				
Most of the people I spend time with	1.951	0.095	0.0001	0.836

are smokers.				
A lot of my friends or family smoke.	1.863	0.106	0.0001	0.795
Most of my friends and acquaintances smoke.	2.194	0.079	0.0001	0.931
Taste/Sensory Processes				
I enjoy the taste of cigarettes most of the time.	1.666	0.102	0.0001	0.787
The flavor of a cigarette is pleasing.	1.931	0.088	0.0001	0.862
Most of my daily cigarettes taste good.	1.813	0.100	0.0001	0.850
Weight Control				
Smoking keeps me from gaining weight.	1.530	0.128	0.0001	0.760
I rely upon smoking to control my hunger and eating.	1.393	0.146	0.0001	0.727
Weight control is a major reason that I smoke.	1.226	0.143	0.0001	0.762

Table 8. Second Order CFA Results

Items	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Affiliative Attachment	1.676	0.292	0.0001	0.859
Automaticity	2.847	1.052	0.0070	0.944
Cognitive Enhancement	0.991	0.189	0.0001	0.704
Craving	0.608	0.103	0.0001	0.520
Negative Reinforcement	0.543	0.131	0.0001	0.477
Social/Environmental Goads	1.063	0.138	0.0001	0.728
Taste/Sensory Processes	0.222	0.077	0.0040	0.217
Weight Control	0.419	0.100	0.0001	0.368

Table 9. Cronbach's Alphas for WISDM-30 and each of the 10 Subcales

	Cronbach's Alpha	**Number of Items**
WISDM-30	.907	30
WISDM-30 Subscales		
Affiliative Attachment	.794	3
Automaticity	.737	3
Cognitive Enhancement	.871	3
Craving	.778	3
Cue Exposure/Associative Processes	.608	3
Loss of Control/Tolerance	.604	3
Negative/Positive Reinforcement	.789	3
Social/Environmental Goads	.884	3
Taste/Sensory Processes	.873	3
Weight Control	.769	3
	Cronbach's Alpha	**Number of Items**
WISDM-27	.902	27
WISDM-27 Subscales		
Affiliative Attachment	.794	3
Automaticity	.737	3
Cognitive Enhancement	.871	3
Craving	.831	6
Negative/Positive Reinforcement	.789	3
Social/Environmental Goads	.884	3
Taste/Sensory Processes	.873	3
Weight Control	.769	3

Table 10. Correlations between each of the 8 WISDM-27 Subscales

	Affiliative Attachment	Automaticity	Cognitive Enhancement	Craving	Negative Reinforcement	Social Goads	Taste/ Sensory Processes
Affiliative Attachment							
Automaticity	.412**						
Cognitive Enhancement	.518**	.248**					
Craving	.537**	.412**	.507**				
Negative Reinforcement	.505**	.269**	.702**	.550**			
Social Goads	.129**	.127**	.145**	.195**	.171**		
Taste/ Sensory Processes	.354**	.244**	.355**	.332**	.417**	.107*	
Weight Control	.244**	.170**	.303**	.192**	.302**	.138**	.176**

<.05*, <.01**, <.001***

Table 11. Correlations between demographic variables and WISDM-27 subscales

	Affiliative Attachment	Automaticity	Cognitive Enhancement	Craving	Negative Reinforce-ment	Social Goads	Taste/ Sensory Processes	Weight Control
Age	.067	-.020	-.047	-.150**	-.181***	-.161***	.005	.020
Gender	.016	.043	-.021	.013	.030	-.105*	-.062	.104
Marital status	.052	.075	.007	.027	.058	.109*	.013	.046
Employment	-.029	-.009	-.031	.077	-.017	.023	-.023	-.056
Income	.038	.035	.080	-.018	.090*	-.024	.079	.043
Education	.030	-.018	-.019	-.050	-.033	-.199***	-.150**	-.043

<.05*, <.01**, <.001***

Table 12. Correlations Between WISDM-27 Subscales and Tobacco-Related Variables

	Affiliative Attachment	Automaticity	Cognitive Enhancement	Craving	Negative Reinforcement	Social Goads	Taste/ Sensory Processes	Weight Control
CPD	.199***	.206***	.189***	.324***	.152**	.010	.088*	.030
Age smoked regularly	-.047	-.139**	-.139*	-.148**	-.089*	-.126**	-.097*	.010
Number of years smoked	.089*	.062	.011	-.053	-.115**	-.076	.061	.012
Number quit attempts in past year	.020	.028	.006	-.010	.024	.084	-.008	.070
Number of quit attempts in lifetime	.018	-.009	-.065	-.016	.006	-.029	.019	-.032
TTFC	-.160***	-.127***	-.150***	-.232**	-.160***	-.008	-.129**	-.064
FTND	.327***	.270***	.249***	.394***	.223***	.099*	.248***	.120**
MNWS	.267***	.145**	.254***	.321***	.305***	.134***	.108*	.209***
QSU-brief	.477***	.300***	.463***	**.532*** **	.488***	.241***	.251***	.532***
QSU-brief factor 1	.416***	.280***	.408***	**.532*** **	.439***	.225***	.383***	.232***
QSU-brief factor 2	.494***	.286***	.474***	.461***	.490***	.231***	.404***	.244***

<.05*, <.01**, <.001***

Table 13. SEM Results with CPD and WISDM-27 Subscales

Items	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Affiliative Attachment	0.080	0.029	0.005	0.199
Automaticity	0.071	0.031	0.020	0.177
Cognitive Enhancement	0.106	0.026	<0.001	0.259
Craving	0.166	0.032	<0.001	0.386
Negative Reinforcement	0.093	0.030	0.002	0.228
Social Influences	-0.016	0.026	0.551	-0.039
Taste/Sensory Processes	0.027	0.027	0.324	0.067
Weight Control	0.001	0.030	0.971	0.003

Table 14. SEM Results with CPD and Tobacco Related Variables

Variable	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Fagerström Test of Nicotine Dependence	0.339	0.056	<0.001	0.135
Time to first cigarette	-0.331	0.068	<0.001	-0.131
Minnesota Withdrawal Scale	0.076	0.070	0.273	0.030
QSU-Brief Factor 1	0.140	0.071	0.048	0.056
QSU-Brief Factor 2	0.084	0.074	0.257	0.033
Age started smoking regularly	0.011	0.060	0.853	0.004
Number of years smoked	0.076	0.063	0.227	0.030

Table 15. Path Analysis Focusing on CPD and WISDM-27 Subscales

	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
WISDM-27 Subscales				
Affiliative Attachment	0.190	0.047	<0.001	0.216
Automaticity	0.225	0.052	<0.001	0.264
Cognitive Enhancement	0.116	0.054	0.031	0.141
Craving	0.181	0.045	<0.001	0.267
Negative Reinforcement	0.086	0.056	0.120	0.099
Social Influences	0.055	0.059	0.355	0.056
Taste/Sensory Processes	0.104	0.057	0.067	0.118
Weight Control	0.034	0.046	0.460	0.045
Tobacco Related Variables				
Fagerström Test of Nicotine Dependence	0.192	0.045	<0.001	0.255
Time to First Cigarette	-0.175	0.062	0.005	-0.204
Minnesota Withdrawal Scale	-0.034	0.207	0.869	-0.011
QSU-Brief Factor 1	0.094	0.059	0.113	0.101
QSU-Brief Factor 2	0.035	0.520	0.494	0.049
Age started smoking regularly	-0.020	0.170	0.907	-0.006
Number of years smoked	0.390	0.380	0.305	0.066

Table 16. Differences between Gender, WISDM-27 Subscale Scores, and Tobacco Related Variables

Variable, Mean (SD)	Men	Women	Cohen's d	p value
WISDM-27 Subscales				
Affiliative Attachment	2.84 (1.85)	2.91 (1.83)	-0.04	.715
Automaticity	3.54 (1.70)	3.70 (1.87)	-0.09	.335
Cognitive Enhancement	2.92 (1.88)	2.84 (1.86)	0.04	.632
Craving	4.59 (1.50)	4.63 (1.46)	-0.03	.765
Negative Reinforcement	3.49 (1.88)	3.60 (1.82)	-0.06	.503
Social Environmental Goads	4.17 (2.01)	3.71 (2.14)	0.22	.017
Taste/Sensory Processes	4.16 (1.98)	3.91 (1.89)	0.13	.160
Weight Control	2.08 (1.50)	2.43 (1.46)	-0.24	.019
Tobacco Related Variables				
Fagerström Test of Nicotine Dependence	3.04 (1.64)	3.16(1.68)	-0.07	0.484
Minnesota Withdrawal Scale	9.63 (6.59)	9.61 (6.91)	0.01	.976
QSU-Brief Factor 1	3.48 (2.02)	3.57 (2.05)	-0.04	.671
QSU-Brief Factor 2	2.24 (1.53)	2.20 (1.52)	0.03	.761
Age started smoking regularly	21.15 (7.27)	21.14 (7.01)	0.01	.999
Number of years smoked	26.91(12.11)	24.11 (12.12)	0.23	.014

Table 17. SEM Results with Gender and WISDM-27 Subscales

Items	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Affiliative Attachment	0.039	0.146	0.790	0.019
Automaticity	0,065	0,144	0.650	0.032
Cognitive Enhancement	-0.027	0.142	0.848	-0.013
Craving	0.106	0,145	0.464	0.051
Negative Reinforcement	0.076	0.151	0.616	0.037
Social Influences	-0.315	0.143	0.028	-0.150
Taste/Sensory Processes	-0.093	0.140	0.507	-0.045
Weight Control	0.305	0.142	0.032	0.146

Table 18. SEM Results with Gender and Tobacco Related Variables

Variable	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
Fagerström Test of Nicotine Dependence	0.217	0.214	0.311	0.062
Time to first cigarette	-0.145	0.287	0.612	-0.039
Minnesota Withdrawal Scale	0.067	0.144	0.643	0.032
QSU-Brief Factor 1	0.104	0.132	0.431	0.050
QSU-Brief Factor 2	0.144	0.188	0.442	0.049
Age started smoking regularly	0.725	0982	0.460	0.042
Number of years smoked	-3.694	1.488	0.013	-0.150

Table 19. Path Analysis Focusing on Gender, WISDM-27 Subscales, and Tobacco Related Variables

	Parameter Estimate	Standard Error	P Value	Standardized Parameter Estimate
WISDM 27 Subscales				
Affiliative Attachment	-0.010	0.259	0.969	-0.005
Automaticity	0.156	0.251	0.533	0.085
Cognitive Enhancement	-0.091	0.243	0.709	-0.051
Craving	-0.087	0.198	0.659	-0.059
Negative Reinforcement	0.115	0.261	0.660	0.061
Social Influences	-0.475	0.275	0.085	-0.227
Taste/Sensory Processes	-0.378	0.264	0.153	-0.197
Weight Control	0.280	0.217	0.197	0.171
Tobacco Related Variables				
Fagerström Test of Nicotine Dependence	-0.013	0.224	0.953	-0.008
Time to first cigarette	-0.290	0.293	0.322	-0.160
Minnesota Withdrawal Scale	-0.377	0.893	0.673	-0.056
QSU-Brief Factor 1	-0.101	.0279	0.718	-0.050
QSU-Brief Factor 2	-0.267	0.218	0.221	-0.171
Age started smoking regularly	-0.318	1.038	0.759	-0.046
Number of years smoked	-2.509	1.750	0.152	-0.196

Figure 1: Scree Plot from Un-rotated Factor Matrix

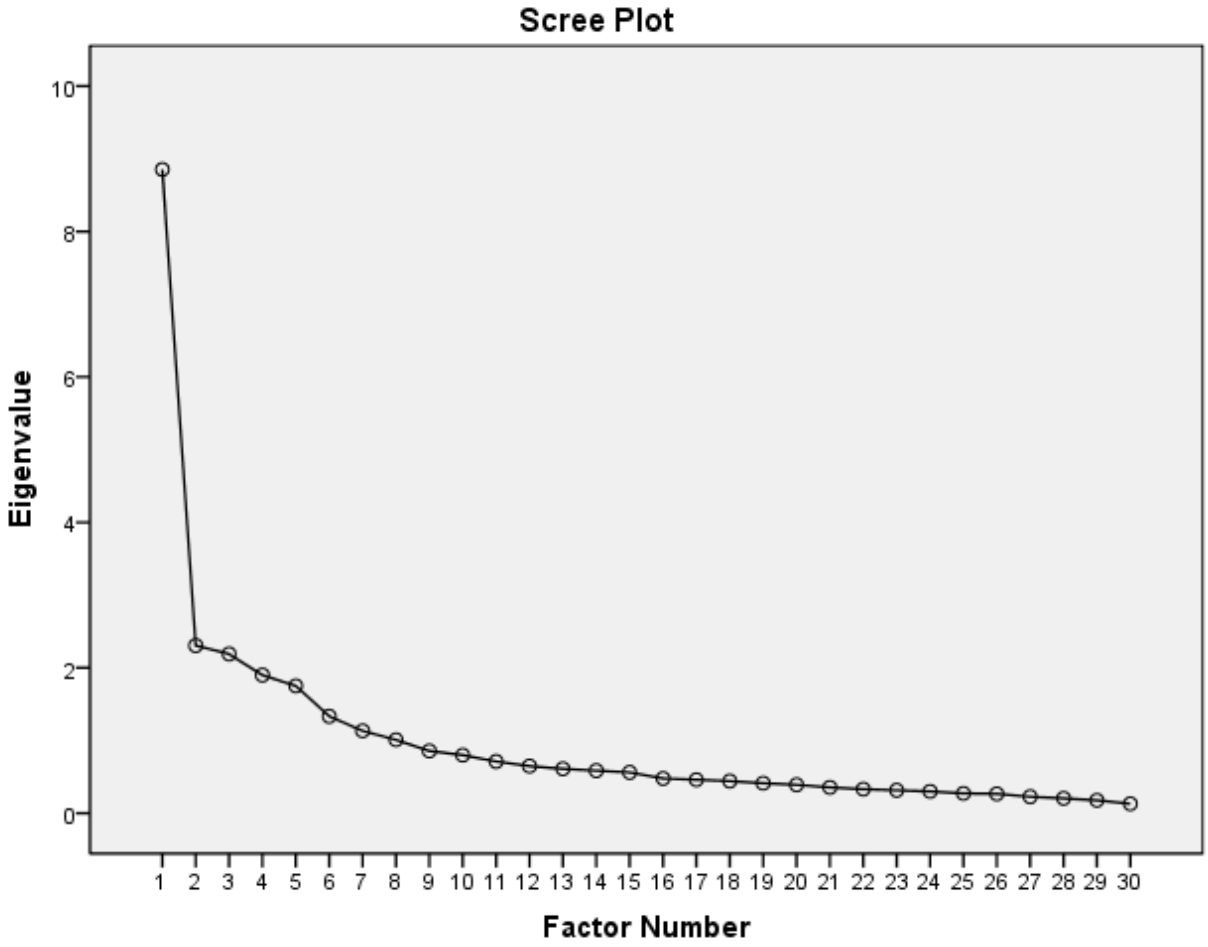


Figure 2. SEM Findings by CPD and WISDM-27 Subscale Scores

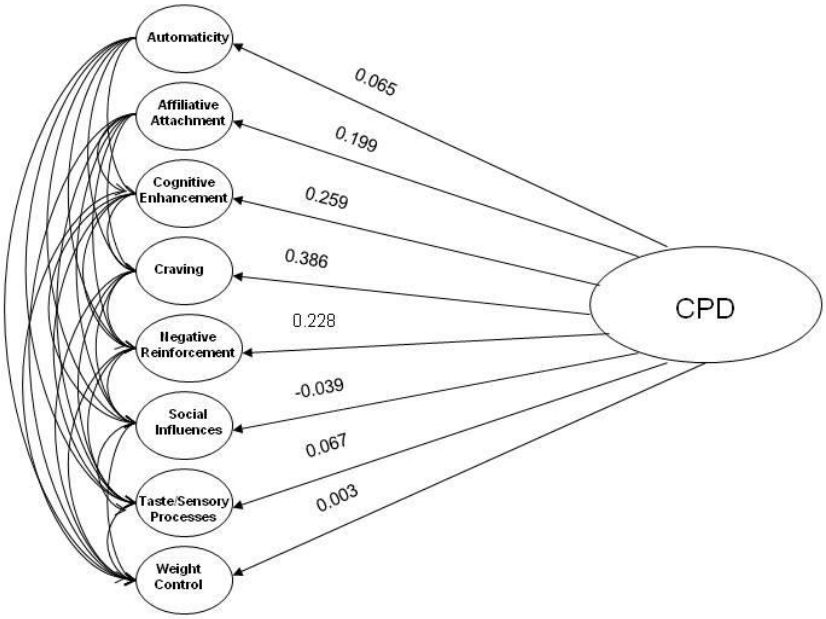


Figure 3. SEM Findings of CPD by Tobacco Related Variables

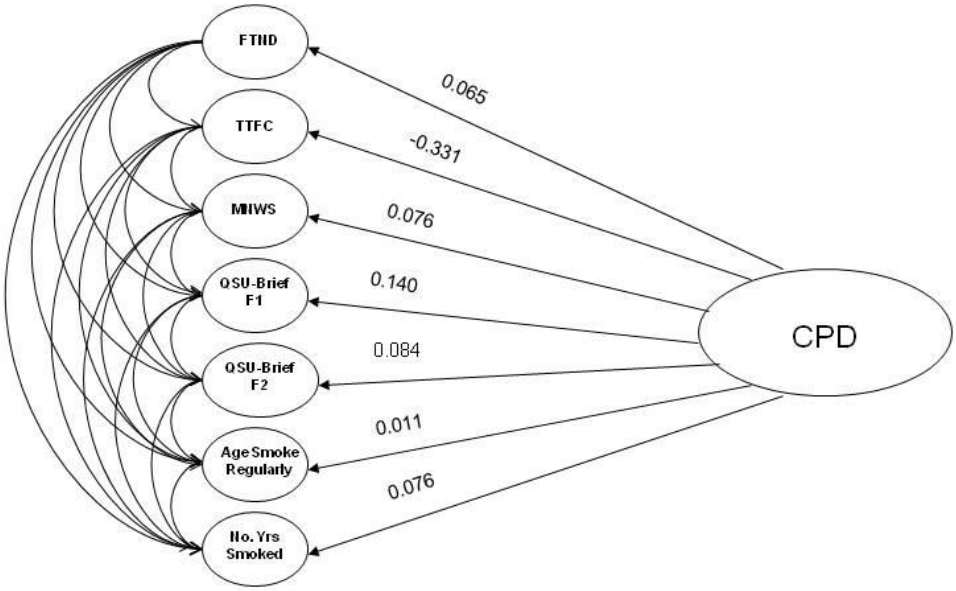


Figure 4. SEM Findings of Gender by WISDM-27 Subscales

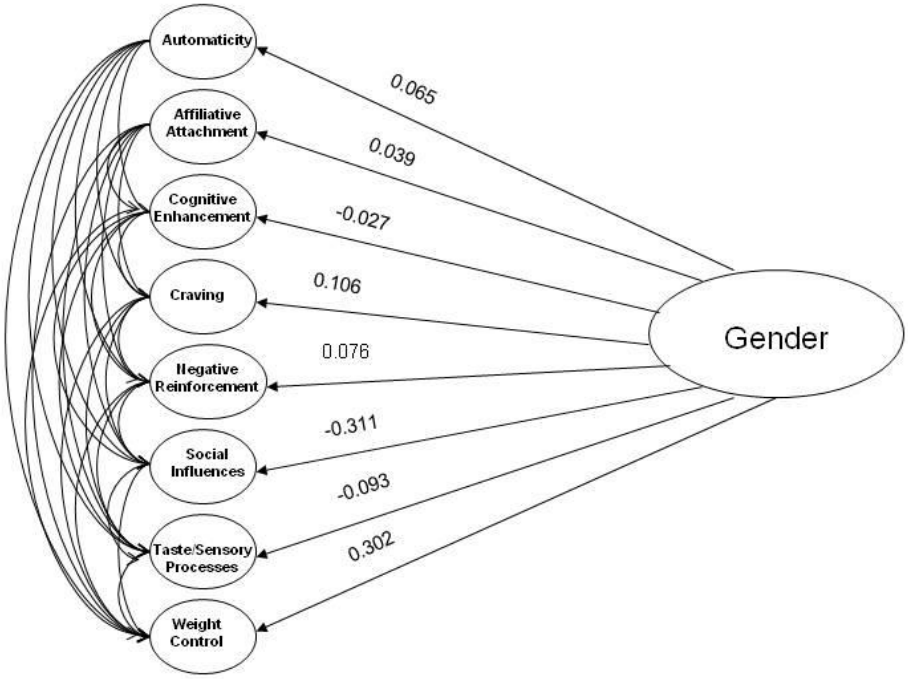


Figure 5. SEM Findings for Gender by Tobacco Related Variables

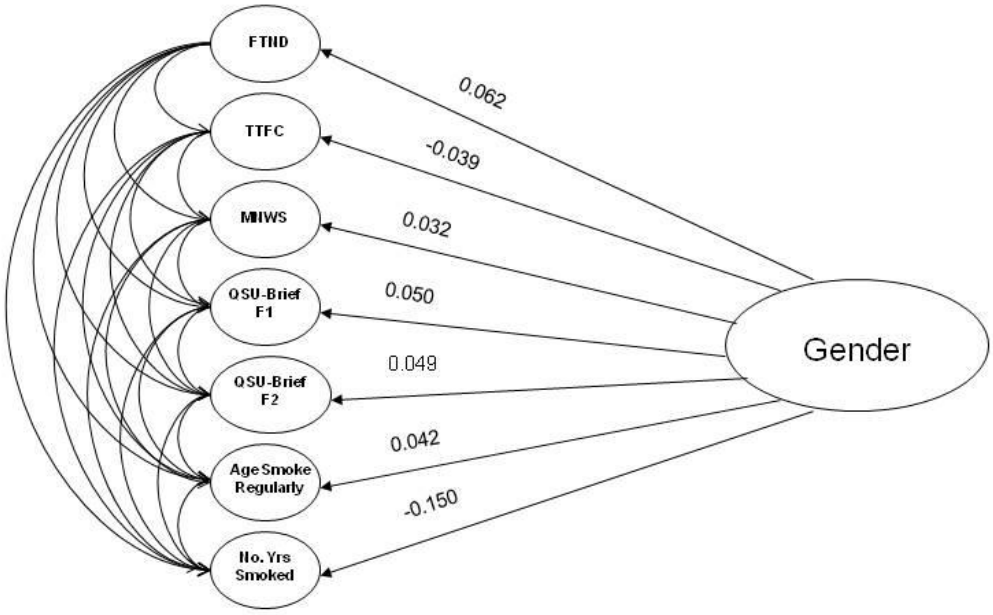


Figure 6. Path Analysis Results for CPD, WISDM-27 Subscales, and Tobacco Related Variables

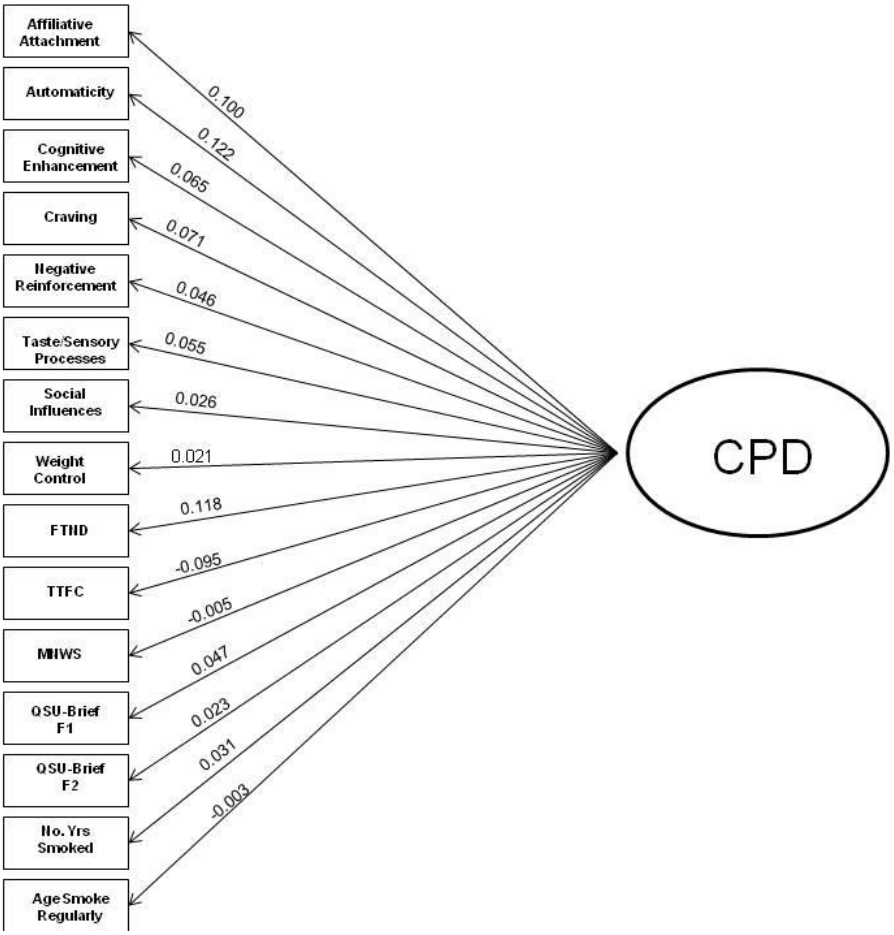
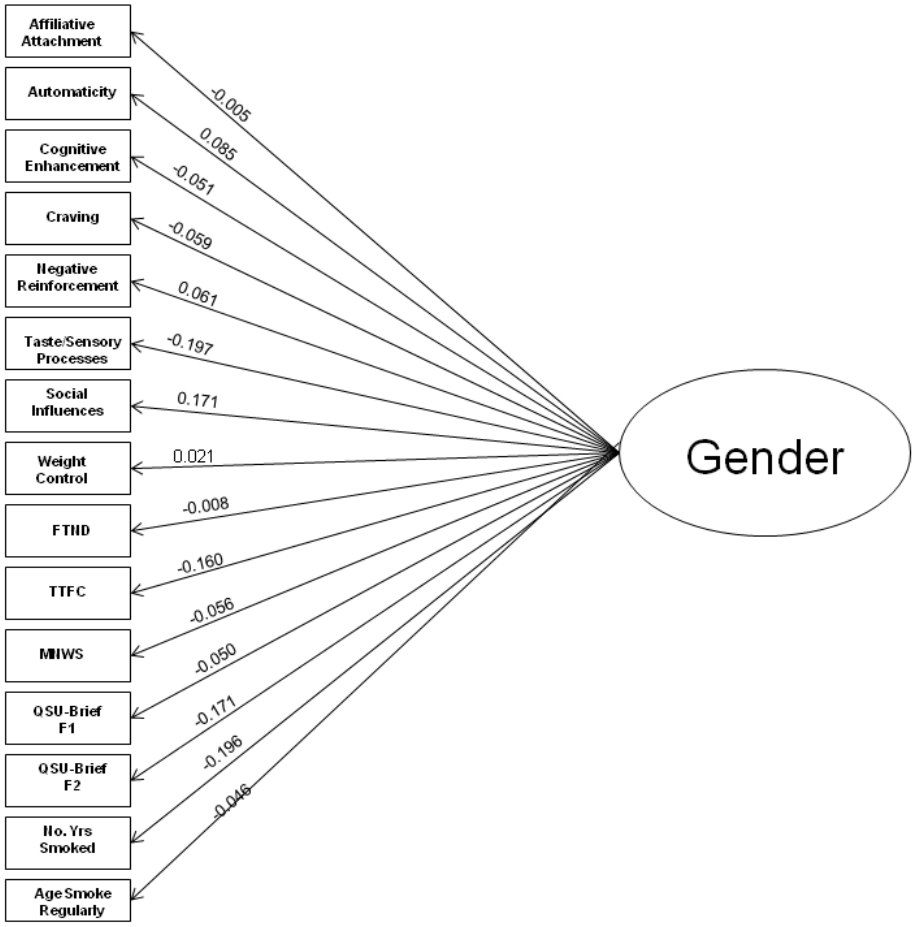


Figure 7. Path Analysis Results for Gender, WISDM-27 Subscales, and Tobacco Related Variables



Appendix A: Items from the Fagerström Test of Nicotine Dependence

1. How soon after you wake up do you smoke your first cigarette?

   Within 5 minutes = 3

   6-30 minutes = 2

   31-60 minutes = 1

   After 60 minutes = 0

2. Do you find it difficult to refrain from smoking in places where it is forbidden (e.g., in church, at the library, in the cinema, etc.)?

   Yes = 1

   No = 0

3. Which cigarette would you most hate to give up?

   The first one in the morning = 1

   All others = 0

4. How many cigarettes/day do you smoke?

   10 or less = 0

   11-20 = 1

   21-30 = 2

   31 or more = 3

5. Do you smoke more frequently during the first hours after waking than during the rest of the day?

   Yes = 1

   No = 0

6. Do you smoke if you are so ill you that you are in bed most of the day?

   Yes = 1

   No = 0

Appendix B: WISDOM-68 Subscales: Title and Description

Subscale	Description
Affiliative attachment	strong emotional tie to cigarettes
Automaticity	smoking without awareness
Behavioral choice melioration	smoking despite consequences
Cognitive enhancement	smoking to improve mental function
Craving	desire/urge to smoke
Cue exposure	associative processes-perceived link between stimuli in the environment a desire to smoke
Loss of control	person cannot control smoking habit
Negative reinforcement	desire to smoke to relieve negative internal states
Positive reinforcement	desire to smoke to enhance/increase positive internal states
Social/environmental goads	social stimuli that prompts smoking
Taste/sensory properties	desire to smoke to experience oral, tactile, or other sensory experiences related to smoking
Tolerance	smoke more to get the same effect
Weight control	use cigarettes to manage weight or lose weight